Upper Owyhee Watershed Subbasin Assessment and Total Maximum Daily Load Owyhee County, Idaho

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Abbreviations, Acronyms, and Symbols

303(d) Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section

§ Section (usually a section of federal or state rules or statutes)

Ag Plan Agricultural Pollution Abatement Plan

BIA Bureau of Indian Affairs

BLM United States Bureau of Land Management

BMP best management practice

BURP Beneficial Use Reconnaissance Program

C Celsius

CFR Code of Federal Regulations (refers to citations in the federal administrative rules)

cfs cubic feet per second

CWA Clean Water Act

CWAL Cold water aquatic life

DEQ Department of Environmental Quality

DO dissolved oxygen

EPA Environmental Protection Agency

F Fahrenheit

GIS Geographical Information Systems

HUC Hydrologic Unit Code

IDA Department of Agriculture

IDAPA Refers to citations of Idaho administrative rules

IDFG Idaho Department of Fish and Game

IDWR Department of Water Resources

km kilometer

km^2 square kilometer

LA load allocation

load capacity load capacity

m meter

m^2 square meter

MBI macroinvertebrate biotic index

mg/l milligrams per liter

mm millimeter

MOS margin of safety

NB natural background

ND no data (data not available)

NPDES National Pollutant Discharge Elimination System

NRCS Natural Resources Conservation Service

NTU nephelometric turbidity unit

ORMP Owyhee Resource Management Plan

PCR primary contact recreation

SBA subbasin assessment

SCR secondary contact recreation

SCC Soil Conservation Commission

SCD Soil Conservation District

SSShade Stream Segment Shade

SSTemp Stream Segment Temperature

STATSGO State Soil Geographic Database

TMDL total maximum daily load

USC United States Code

USDA United States Department of Agriculture

USGS United States Geological Survey

WAG Watershed Advisory Group

WLA wasteload allocation

YOY Young of the year

Executive Summary

The federal Clean Water Act requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to section 303 of the Clean Water Act are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the Clean Water Act establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load for the pollutants, set at a level to achieve water quality standards. This document addresses the water bodies in the Upper Owyhee Watershed Subbasin that have been placed on what is known as the "§303(d) list."

This subbasin assessment and total maximum daily load analysis has been developed to comply with Idaho's total maximum daily load schedule. This assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Upper Owyhee Watershed Subbasin located in southwest Idaho. The first part of this document, the subbasin assessment, is an important first step in leading to the total maximum daily load. The starting point for this assessment was Idaho's current §303(d) list of water quality limited water bodies. Nine segments of the Upper Owyhee Watershed Subbasin were listed on this list. The subbasin assessment portion of this document examines the current status of §303(d) listed waters, and defines the extent of impairment and causes of water quality limitation throughout the subbasin. The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards.

Subbasin at a Glance

Upper Owyhee River Subbasin	
HUC#:	17050104
SWB#:	230
Streams:	Red Canyon Cr., Nickel Cr., Deep Cr., Pole Cr., Battle Cr., Castle Cr., Shoofly Cr.
Reservoirs:	Juniper Basin, Blue Creek
Pollution Sources:	Nonpoint Sources
Ecoregion:	Snake River-High Desert
Size (Total):	1,384,288 Acres
Size (Idaho):	1,012,411 Acres

Figure A. Vicinity Map

The Upper Owyhee Subbasin, hydrologic unit code 17050104, encompasses a large area in southwest Idaho. The headwaters for the Owyhee River (East Fork) originate in northeast Nevada in the Independence Mountains. The watershed size is 1,384,288 acres total, with 1,012,411 acres within the state of Idaho and the Shoshone-Paiute Duck Valley Indian Reservation.

Within the Idaho portion of the watershed, there are nine water quality limited segments that were placed on the Idaho 1998 §303(d) list. Two segments are reservoirs, Juniper Basin and Blue Creek Reservoirs. One segment that was listed on the Idaho 1994 §303(d) list (Blue Creek) was removed from the list in 1998.

Listed pollutants of concern are sediment, bacteria, flow alteration and temperature. In accordance with the Beneficial Use Reconnaissance Program's Stream Macroinvertebrate Index scores and water quality samples, impaired beneficial uses included cold water aquatic life and primary contact recreation. Those water bodies determined to be not fully supporting their designated or existing beneficial uses and not meeting applicable water quality standards are required to have a total maximum daily load developed.

Figure B shows the Idaho 1998 §303(d) listed segments in the Upper Owyhee Watershed. Table A details each listed segments, impaired uses and pollutant(s) of concern.

Through the Upper Owyhee Watershed subbasin assessment process it was determined that most streams on the Idaho 1998 §303(d) list in the Upper Owyhee Watershed have cold water aquatic life and salmonid spawning as existing uses. In some cases, data show these uses are not supported due to exceedences of the state of Idaho Water Quality Standard temperature criteria.

In other cases, biological information showed impairment to cold water aquatic life and salmonid spawning. For those streams listed as not supporting primary and secondary contact recreation due to the presence of bacteria, monitoring has indicated those streams are full support.

A total maximum daily load has been developed for each stream determined to be not fully supporting beneficial uses in accordance with state of Idaho water quality standards. The total maximum daily loads address temperature reductions required to meet state of Idaho water quality standard criteria and/or in-stream sediment goals to maintain or restore cold water aquatic life and salmonid spawning. The total maximum daily loads use management objectives dealing with riparian conditions to obtain these goals.

Each segment will be addressed separately in this executive summary. Table B shows a breakdown of the findings in the subbasin assessment and actions to be taken (i.e., de-list, list or develop total maximum daily load).

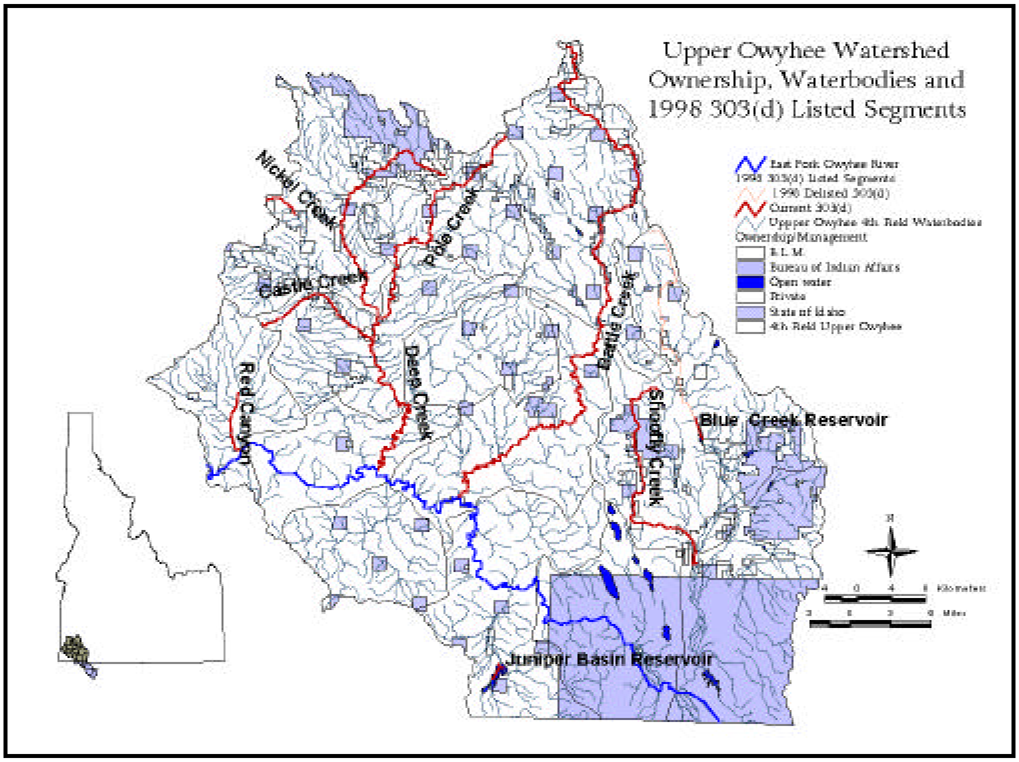


Figure B. Upper Owyhee Watershed Ownership, Water Bodies and the Idaho 1998 §303(d) Listed Segments.

Table A. Upper Owyhee Watershed 1998 §303(d) listed Segments, Descriptions, Listed Pollutants, Impaired Existing Uses, 5th Field HUCs and Miles (or Acres) of Streams Impaired.

Idaho 1998 §303(d) listed Segment	Description	Idaho 1998 §303(d) listed Pollutant(s)	Impaired Uses	5th Field HUC (s)	Idaho 1998 §303(d) listed Miles or Acres Impaired
Blue Creek Reservoir	Reservoir	Sediment	Cold Water Aquatic Life and Salmonid Spawning	Blue Creek Reservoir	185 acres
Juniper Basin Reservoir	Reservoir	Sediment	Cold Water Aquatic Life and Salmonid Spawning	Yatahoney	750 acres
Deep Creek	Mud Flat Road to Confluence with EF Owyhee	Sediment and Temperature	Cold Water Aquatic Life and Salmonid Spawning	Hurry Back, Deep Creek, Dickshooter, Pole Creek and Lower Owyhee	35 miles
Pole Creek	Headwaters to Confluence with Deep Creek	Sediment, Temperature, and Flow	Cold Water Aquatic Life and Salmonid Spawning	Pole Creek	24.1 miles
Castle Creek	Headwaters to Confluence with Deep Creek	Sediment and Temperature	Cold Water Aquatic Life and Salmonid Spawning	Deep Creek	11.3 miles
Battle Creek	Headwaters to Confluence with EF Owyhee	Bacteria	Primary and Secondary Contact Recreation	Upper Battle Creek and Lower Battle Creek	62.5 miles
Shoofly Creek	Headwaters to Confluence with Blue Creek	Bacteria	Primary and Secondary Contact Recreation	Blue Creek Reservoir	22.9 miles
Red Canyon Creek	Headwaters to Confluence with EF Owyhee	Sediment, Temperature, and Flow	Cold Water Aquatic Life and Salmonid Spawning	Red Canyon	5.2 miles
Nickel Creek	Headwaters to Mud Flat Road	Sediment	Cold Water Aquatic Life and Salmonid Spawning	Hurry Back	2.8 miles

There are no known point source discharges on any of the Idaho 1998 §303(d) listed segments. Any activity to address the goals and targets of the total maximum daily load will need to be undertaken through the use of best management practices on the current land uses. The goal of the total maximum daily loads is to achieve state of Idaho water quality standards for temperature and sediment, and to restore and maintain a healthy and balanced biological community for the full support of cold water aquatic life and salmonid spawning. The load allocations and targets will consist of heat reductions for temperature and sediment allocations based on land use. Surrogate measures of total shade and substrate targets will be presented to assist in achieving the load allocations.

Table B. Upper Owyhee Watershed 1998 §303(d) listed Segments and Recommended Actions.

Water Body	Pollutant(s)	TMDL(s) Completed	Recommended Changes to 1998 §303(d) list	Proposed Future Listing-Pollutant of Concern	Justification
Blue Creek Reservoir	Sediment	Yes Sediment	None	None	None
Juniper Basin Reservoir	Sediment	Yes Sediment	None	None	None
Deep Creek	Sediment and Temperature	Yes Sediment and Temperature	List Dissolved Oxygen as Pollutant of Concern	None	None
Pole Creek	Sediment, Temperature and Flow[1]	Yes Temperature	De-List Sediment as a Pollutant of Concern	None	None
Castle Creek	Sediment and Temperature	Yes Sediment and Temperature	None	None	None
Battle Creek	Bacteria	No	De-List Bacteria as a Pollutant of Concern, List Temperature as a Pollutant of Concern	Temperature	BLM[2] Temperature Data Indicated Exceedence of Temperature Criteria
Shoofly Creek	Bacteria	No	De-List Bacteria as a Pollutant of Concern	None	None
Red Canyon Creek	Sediment, Temperature and Flow	Yes Temperature	De-List Sediment as a Pollutant of Concern	None	None
Nickel Creek	Sediment	Yes Sediment	List Temperature Organic Enrichment and Metals as Pollutants of Concern	None	Idaho DEQ Temperature Data Indicated Exceedence of Temperature Criteria

1 No TMDL for Flow per Idaho DEQ policy, 2 Bureau of Land Management

Key Findings

Blue Creek Reservoir

1998 §303(d) listed:	Reservoir, 185 acres
Size:	Blue Creek Reservoir 5th Field HUC 136,477 acres
Impaired Existing Uses:	Cold Water Aquatic Life
Pollutant of Concern:	Sediment
TMDL Goal:	In-Reservoir Turbidity Levels to Provide Full Support for Cold Water Aquatic Life
TMDL Reduction Required:	Reduction in Turbidity Levels and Sediment Loads from Upstream Sources
Identified Sources:	Rangeland, Streambanks and Overland Erosion

Blue Creek Reservoir is a small in-stream impoundment located on Blue Creek in the Blue Creek Reservoir 5th Field HUC. The reservoir is approximately 185 acres in size and has a storage capacity of 250 acre/feet. The primary water use is irrigation water storage. In 2000, the Idaho Department of Fish and Game introduced domestic Kamloops trout in the reservoir. With the stocking of the Kamloops, the reservoir has been determined to have cold water aquatic life as an existing use and criteria to support this existing use therefore applies.

The listed pollutant of concern is sediment. Biological monitoring conducted in 2001 indicated sediment is impairing the biological communities. Thus, a total maximum daily load has been developed to address turbidity levels and an in-reservoir target of 25 nephelometric turbidity units has been established to obtain full support of cold water aquatic life. All other beneficial uses appear to be fully supported, including primary contact recreation. No other data was presented to indicate water supply, wildlife habitat or aesthetics beneficial uses are not fully supported.

Juniper Basin Reservoir

1998 §303(d) listed:	Reservoir, 749 acres
Size:	Yatahoney 5th Field HUC 107,994 acres
Presumed Existing Uses:	Cold Water Aquatic Life
Pollutant of Concern:	Sediment
TMDL Goal:	In-Reservoir Turbidity Levels to Provide Full Support for Cold Water Aquatic Life
TMDL Reduction Required:	Reduction in Turbidity Levels and sediment Loads from Upstream Sources
Identified Sources:	Rangelands, Streambanks and Overland Erosion

Juniper Basin Reservoir is a shallow low-lying reservoir located on the desert plateaus west of the Shoshone-Paiute Duck Valley Reservation, and directly north of the state line of Idaho and Nevada. Portions of the reservoir's watershed originate in Nevada. The primary purpose of the reservoir, at one time, was irrigation water storage. However, the irrigation water delivery system has been in disrepair for a long period of time and is no longer operable.

No data were found to determine if aquatic life is an existing use, nor were any data provided to justify the reservoir being placed on the Idaho 1998 §303(d) list. *The Idaho Water Quality Nonpoint Source Assessment* assessed the reservoir as all beneficial uses, except warm water aquatic life, as supported but threatened. However, the assessments were made based on best professional judgement with no data presented to justify the support status of the beneficial uses.

The Idaho Department of Fish and Game's *Fisheries Management Plan* for the Owyhee River has the area around Juniper Basin Reservoir listed for mixed fisheries management. However, it is still not known what the existing aquatic uses are for the reservoir.

Biological monitoring conducted in 2001 indicated sediment is impairing the biological communities. Since it is presumed that Juniper Basin Reservoir can support cold water aquatic life and without information available to determine the status of existing aquatic use, a total maximum daily load has been developed to address turbidity levels in the reservoir. The total maximum daily load is written to address in-reservoir turbidity levels and upstream sediment sources.

Deep Creek

1998 §303(d) listed:	3rd, 4th and 5th Order Stream, 46 miles
Size:	Hurry Back, Deep Creek, Dickshooter, Lower Owyhee, and Pole Creek 5th Field HUCs 255,393 Total Acres
Impaired Existing Uses:	Cold Water Aquatic Life and Salmonid Spawning
Pollutants of Concern:	Sediment and Temperature
TMDL Goals:	Sediment: In Stream Substrate Percent Fines (<6 mm) of 30% or Less, Streambank Erosion Rates and Sediment Load Allocation Temperature: Achieve State Water Quality Standards for the Full Support of Salmonid Spawning Through Reduced Solar Radiation
Identified Sources:	Streambank Conditions, Overland Erosion and Solar Radiation

Deep Creek is the largest subwatershed in the Upper Owyhee Watershed and covers one quarter million acres of mostly federal and state managed lands. Deep Creek is a 5th order stream at its confluence with the East Fork Owyhee River. The stream flows through mostly incised canyons in the lower sections of the Y-P Desert. The stream gradient is usually less than 2%. The creek has many long sections of shallow glides broken by short sections of riffles. Large sections of cobble-gravel bars are present throughout most of the lower sections, with sand and pea gravel in the upper section's substrate.

Past Beneficial Use Reconnaissance Program Macroinvertebrate Biotic Index scores were varied. Some scores indicated cold water aquatic life was fully supported, while others indicated not fully supported or needs verification. With mixed information on the status of cold water aquatic life support, Deep Creek remained on the Idaho 1998 §303(d) list. The Idaho Department of Fish and Game's *Fisheries Management Plan* for the Owyhee River has Deep Creek listed for the management of wild redband trout.

To determine if sediment is impairing cold water aquatic life, the biological indicator communities of macroinvertebrates and periphyton were examined. Periphyton analyses showed that some sections of Deep Creek are severely impaired by sediment, while others are not. Some periphyton data indicated organic enrichment is a minor impairment during certain periods of the late spring and summer.

Macroinvertebrate data analyses showed that many of the samples collected had Plecoptera species that were mostly moderately tolerant of fine sediment. No species were found that were intolerant of fine sediment. These data indicates sediment is impairing the cold water aquatic life in Deep Creek. Since these samples represented two variations in the stream's hydrograph, it is concluded that sediment is impairing cold water aquatic life throughout the summer, and this includes sediment both in the water column and as bedload.

A sediment load allocation has been written for Deep Creek based on suspended sediment criteria established in other total maximum daily loads to maintain or restore existing uses. Also, an in-stream goal of percent fines (<6 mm) of 30% or less for the substrate and streambank erosion rates for Deep Creek will be established.

Water temperature data from June 1 through September 30, 2000 and 2001, indicated the state of Idaho water quality criteria for the protection of cold water aquatic life and salmonid spawning are exceeded on almost every date that temperature data are available. The Stream Segment Temperature Model was used to calculate heat reduction required to achieve state of Idaho water quality standards. Through the use of Stream Segment Temperature Model, it was calculated that the shading of the stream would have to be between 80 and 100%. This value is also for all streams within the Deep Creek Watershed. Calculations also showed that if the temperature criteria are not met on tributary segments within the watershed, the temperature target would not be met in Deep Creek as well for the month of June.

Pole Creek

1998 §303(d) listed:	3rd Order Stream, 24 miles
Size:	Pole Creek 5th Field HUC 54,550 Total Acres
Impaired Existing Uses:	Cold Water Aquatic Life and Salmonid Spawning
Pollutants of Concern:	Sediment, Temperature, and Flow Alteration
TMDL Goal:	Temperature: Achieve State Water Quality Standards for the Full Support of Salmonid Spawning Through Reduced Solar Radiation
Identified Source:	Solar Radiation

Past Beneficial Use Reconnaissance Program information showed mixed results when used to determine cold water aquatic life support status. The Idaho Department of Fish and Game's *Fisheries Management Plan* for the Owyhee River has Pole Creek (a tributary of Deep Creek) listed for management of wild redband trout.

To determine if sediment were impairing cold water aquatic life, periphyton samples were examined to determine if the biological indicators are affected. Periphyton analysis showed that there was no indication that sediment is impairing cold water aquatic life. Thus, no total maximum daily load will be developed for sediment. Sediment should be removed as a pollutant of concern for Pole Creek.

Water temperature data from June 1 through September 30, 2000 and 2001, indicate the state of Idaho water quality criteria for the protection of cold water aquatic life are exceeded between 44-86% of all dates sampled. For salmonid spawning, 100% of all dates sampled June 1 through July 1 exceeded the criteria. Through the use of Stream Segment Temperature Model, it was calculated that the shading of the stream would have to be between 80-100%. This value is also for all streams within the Pole Creek Watershed. Calculations showed if the temperature criteria is not met on tributary segments within the watershed, the temperature targets will not be met in Pole Creek in the month of June.

Castle Creek

1998 §303(d) listed:	3rd Order Stream, 11.5 miles
Size:	Deep Creek 5th Field HUCs 71,598 Total Acres
Impaired Existing Uses:	Cold Water Aquatic Life and Salmonid Spawning
Pollutants of Concern:	Sediment and Temperature
TMDL Goal:	Sediment: In Stream Substrate Percent Fines (<6 mm) of 30% or Less, Streambank Erosion Rates and Sediment Load Allocation Temperature: Achieve State Water Quality Standards for the Full Support of Salmonid Spawning through Reduced Solar Radiation
Identified Sources:	Streambank Conditions, Overland Erosion and Solar Radiation

Past Beneficial Use Reconnaissance Program data indicated cold water aquatic life was not fully supported. The Idaho Department of Fish and Game's *Fisheries Management Plan* for the Owyhee River has Castle Creek (a tributary of Deep Creek) listed for management of wild redband trout.

To determine if sediment is impairing cold water aquatic life, the biological communities of macroinvertebrates and periphyton were examined. Periphyton analyses showed that some sections of Castle Creek are moderately impaired by sediment. Also, some periphyton data indicated organic enrichment is also a minor impairment during certain periods of the late spring and summer.

Macroinvertebrate data analyses showed that many of the samples collected had Plecoptera species that were mostly moderately tolerant of fine sediment. No species were found that were intolerant of fine sediment. These data indicate sediment is impairing the cold water aquatic life in Castle Creek. Since the samples represented two variations in the stream's hydrograph, it is concluded that sediment is impairing cold water aquatic life throughout the summer, and both this includes water column and bedload sediment.

A sediment load allocation has been written for Castle Creek based on suspended sediment criteria established for other total maximum daily loads to maintain or restore existing uses.

Also, an in-stream goal of percent fines (<6 mm) of 30% or less for the substrate and streambank erosion rates for Deep Creek will be established.

Water temperature data from June 23 through August 24, 2000 and 2001, indicated the state of Idaho water quality criteria for the protection of cold water aquatic life are exceeded 81-100% of all dates sampled. For salmonid spawning, 100% of all dates sampled June 23 through July 1 exceeded the criteria. Through the use of Stream Segment Temperature Model it was calculated that the shading of the stream would have to be between 80-100%.

Battle Creek

1998 §303(d) listed:	1st, 2nd, 3rd, 4th, 5th Order Stream, 62.5 miles
Size:	Upper Battle Creek and Lower Battle Creek 5th Field HUCs 71,598 Total Acres
Impaired Existing Uses:	Primary and Secondary Contact Recreation
Pollutants of Concern:	Bacteria
TMDL Goal:	No TMDL Required
Recommendations:	Limited BLM Data has Indicated Water Temperature Exceeds Water Quality Standards for Cold Water Aquatic Life, List for Temperature on next 303(d) listing Cycle

Battle Creek was listed on the 1998 §303(d) list for the presence of bacteria. The listing was based on one sample out of many samples collected and analyzed for fecal coliform by the Bureau of Land Management. Follow-up monitoring used *E. coli* as the indicator to determine the support status. Results showed primary and secondary contact recreations are fully supported.

Temperature data provided by the Bureau of Land Management for summer 1999 and again in 2000 showed state water quality standards temperature criteria were exceeded. However, for both years the data was limited to a 45 day period. There is not enough information to develop a total maximum daily load at this time, but Battle Creek should be listed for temperature on the next listing cycle and placed on a schedule for subbasin assessment and total maximum daily load development at later date.

Shoofly Creek

1998 §303(d) listed:	1st, 2nd, 3rd Order Stream, 22.85 miles
Size:	Blue Creek Reservoir 5th Field HUCs 136,777 Total Acres
Impaired Existing Uses:	Primary and Secondary Contact Recreation
Pollutants of Concern:	Bacteria
TMDL Goal:	No TMDL Required
Recommendations:	De-List Bacteria as a Pollutant of Concern and Remove from 303(d) list

Shoofly Creek was listed on the 1998 §303(d) list for the presence of bacteria. The listing was based on one sample out of many samples collected and analyzed for fecal coliform. Follow-up monitoring conducted by the Department of Environmental Quality using *E. coli* as the indicator for the support status, determined primary and secondary contact recreation uses were fully supported.

Red Canyon Creek

1998 §303(d) listed:	3rd Order Stream, 5.1 miles
Size:	Red Canyon 5th Field HUCs 49,898 Total Acres
Impaired Existing Uses:	Cold Water Aquatic Life and Salmonid Spawning
Pollutants of Concern:	Sediment, Temperature and Flow Alteration
TMDL Goal:	Temperature: Achieve State Water Quality Standards for the Full Support of Salmonid Spawning Through Reduced Solar Radiation
Identified Sources:	Solar Radiation

Past Beneficial Use Reconnaissance Program data indicated cold water aquatic life was fully supported. The Idaho Department of Fish and Game's *Fisheries Management Plan* for the Owyhee River lists Red Canyon Creek as managed for a mixed fishery (seasonal cold). However, data collected in 1995 showed a diverse age class of redband trout exists in Red Canyon Creek. Thus, salmonid spawning is an existing use and the state of Idaho water quality standards and criteria are applicable to protect the existing use. Red Canyon Creek is designated in the state of Idaho water quality standards for cold water aquatic life and primary contact recreation.

Water temperature data collected from June 23 through July 1, 2000 and 2001 show that the criteria for the support of salmonid spawning was exceeded on all sampled dates. Through the use of Stream Segment Temperature Model it was calculated that the shading of the stream would have to be between 80 and 100%. This value is also for all streams within the Red Canyon Creek Watershed. Calculations showed if the temperature criteria is not met on tributary segments within the watershed, the temperature targets will not be met in Red Canyon Creek.

To determine if sediment was impairing cold water aquatic life, periphyton samples were examined. Periphyton analyses showed that there was no indication that sediment is impairing cold water aquatic life. Thus, no total maximum daily load will be developed for sediment. Sediment should be removed as a pollutant of concern for Red Canyon Creek.

Nickel Creek

1998 §303(d) listed:	3rd Order Stream, 2.7 miles
Size:	Hurry Back 5th Field HUCs 98,405 Total Acres
Impaired Existing Uses:	Cold Water Aquatic Life and Salmonid Spawning
Pollutant of Concern:	Sediment
TMDL Goal:	Sediment: In Stream Substrate Percent Fines (<6 mm) of 30% or Less, Streambank Erosion Rates and Sediment Load Allocation
Identified Sources:	Streambank Conditions, Overland Erosion and Solar Radiation

Past Beneficial Use Reconnaissance Program data indicated cold water aquatic life was not fully supported. The Idaho Department of Fish and Game's *Fisheries Management Plan* for the Owyhee River has Nickel Creek (a tributary of Deep Creek) listed as managed for wild redband trout.

Macroinvertebrate data analyses showed that many of the samples collected had Plecoptera species that were moderately tolerant of fine sediment. No species were found that were intolerant of fine sediment. This data would indicate sediment is impairing the cold water aquatic life in Nickel Creek. Since the samples represented two variations in the stream's hydrograph, it is concluded that sediment is impairing cold water aquatic life throughout the summer, and this includes both water column sediment and bedload sediment. Periphyton analyses showed slight impairment of cold water aquatic life. However, there was no indication that sediment is the source of impairment. Analyses also showed there are possible chronic metal toxicity and organic enrichment.

A total maximum daily load for sediment has been developed to address the most likely source of sediment in Nickel Creek. The sediment load allocation has been written for Nickel Creek based on suspended sediment criteria established for other total maximum daily loads to maintain or restore existing uses. Also, an in-stream goal of percent fines (<6 mm) of 30% or less for the substrate and targeted streambank erosion rates for Nickel Creek was established.

Temperature monitoring was conducted on Nickel Creek for the possible use as a reference stream. Data indicated that Nickel Creek exceeds desired temperature criteria for the support of salmonid spawning. However the data set is limited to 22 days from June 23 to July 15, 2000. Considering that Nickel Creek is not listed on the 1998 §303(d) list for temperature and the lack of sufficient temperature data, it is recommend temperature be placed as a pollutant of concern on the next §303(d) list.

Proposed Listing on Next Idaho §303(d) List

During the development of the Upper Owyhee Watershed subbasin assessment, the Bureau of Land Management provided limited summer temperature data for Camas Creek and Camel Creek, which are tributaries to Pole Creek, and Battle Creek. The data indicated the temperature criteria for the support of cold water aquatic life is exceeded for these water bodies. The data were limited to a period that did not include the timeframe for salmonid spawning and incubation periods. It is recommended these water bodies be listed for temperature on the next Idaho §303(d) list with temperature as the pollutant of concern. Table B describes other suggested changes to the next §303(d) list.

Through the use of the criteria to determine the support status of beneficial uses as outlined in the *Water Body Assessment Guidance* two additional streams were found to be not fully supporting beneficial uses. These water bodies are Dry Creek and Beaver Creek. Table C shows water bodies that should be placed on the next cycle for the next §303(d) listing.

Table C. Additional Water Quality Limited Segments to be Listed as Water Quality Limited and/or Pollutants of Concern Placement on Next §303(d) List. Upper Owyhee Watershed.

Stream Name	Proposed Pollutant(s) of Concern	Impaired Beneficial Use(s)	Justification for Listing
Battle Creek	Temperature	Cold Water Aquatic Life and Salmonid Spawning	Temperature Data Provided by Bureau of Land Management
Nickel Creek	Temperature and Metals	Cold Water Aquatic Life and Salmonid Spawning	Data Presented in Subbasin Assessment
Camas Creek	Temperature	Cold Water Aquatic Life and Salmonid Spawning	Temperature Data Provided by Bureau of Land Management
Camel Creek	Temperature	Cold Water Aquatic Life and Salmonid Spawning	Temperature Data Provided by Bureau of Land Management
Dry Creek	Unknown	Cold Water Aquatic Life and Salmonid Spawning	As Per Water Body Assessment Guidance
Beaver Creek	Unknown	Cold Water Aquatic Life and Salmonid Spawning	As Per Water Body Assessment Guidance

Time Frame for Meeting Water Quality Standards

The development of an implementation plan can be completed in a timely manner. However, implementation of best management practices may take years and is dependent on available resources, funding and prioritization from land management agencies. A long-term monitoring plan will be developed to determine if the total maximum daily load needs to be refined and to assure goals and targets of the total maximum daily load are being achieved.

Studies have shown the improvement to stream morphology, riparian conditions, streambank stability and stream hyporheic conditions may take anywhere from 20 to 100 years. Medium term management goals such as stream canopy density trends and bank stabilizing vegetation targets could be met in five to ten years. Short term management goals such as changes in vegetation utilization and bank condition could be met in one or two years.

Some biological indicators may respond quickly to reduced sediment input and habitat improvement. Warm water intolerant species may take longer and may not re-establish until benefits from reduced solar radiation and increased ground water effectively cool the water.

Implementation Strategy

The implementation strategy addresses the cursory development of an implementation plan for the Upper Owyhee Watershed. State and federal agencies, which will assist in implementing best management practices to achieve the targets and goals are identified. These agencies are Bureau of Land Management, Idaho Department of Lands, Idaho Soil Conservation Commission and Idaho Department of Environmental Quality.

As with any implementation plan addressing non-point sources, an adaptive management approach will be a critical component of any plan developed for the watershed. As more data is collected, future modification to the load allocation may occur which include more accurate water body sediment loading and water body shading potential. Although not anticipated, possible regulatory strategies are in place and can be addressed through current regulatory authority.

Much of the implementation of best management practices will be dependent on the availability of funding and personnel resources. Current state and federal cost share programs will assist private landowners in addressing load allocations on private holdings. It is expected that the identified state and federal agencies will work closely with Idaho Department of Environmental Quality during all phases of best management practices implementation and best management practices effectiveness evaluation.

Monitoring of the goals and targets stated in the total maximum daily load need to be conducted to determine;

1) if the overall goal of achieving and maintaining compliance with state water quality standards are being meet,
2) if the implemented best management practices are working as designed or if modification need to occur,

3) if load allocations need to be adjusted, and
4) if best management practices are being implemented in a timely manner to address water quality concerns, and

Public Involvement

In December 2001, a presentation to the Southwest Idaho Basin Advisory Group was given to update the group on the development of the Upper Owyhee Watershed Subbasin Assessment and Total Maximum Daily Load. A final update was presented to the group in November 2002.

In August 2002, the document was sent to the Idaho Department of Environmental Quality State Office for administrative and technical review. The Upper Owyhee Watershed Subbasin Assessment and Total Maximum Daily Load document was submitted to the public for a comment period commencing on October 18, 2002 and ending November 22, 2002. However, comments received the week of November 25, 2002 were considered.

Two public meeting were conducted during the week of November 4, 2002. These meeting were held at the Owyhee County Courthouse in Murphy, Idaho and at the Pleasant Valley School located outside Jordan Valley, Oregon. Public notices were published in three local newspapers announcing the release of the document for public comment and location of public meetings.

Notification of the release of the document and the request for comments was sent to members of the North-Middle Fork Owyhee River Watershed Advisory Group and other interested groups/stakeholders. An impromptu meeting was conducted on November 26, 2002 at the Idaho Department of Environmental Quality Boise Regional Office to discuss issues with the document.

1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters (33 USC § 1251.101). States and tribes, pursuant to section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the water bodies in the Upper Owyhee Watershed that have been placed on what is known as the "§303(d) list."

The overall purpose of this SBA and TMDL is to characterize and document pollutant loads within the Upper Owyhee Watershed. The first portion of this document, the subbasin assessment (SBA), is partitioned into four major sections: watershed characterization, water quality concerns and existing beneficial uses status, pollutant source inventory, and a summary of past and present pollution control efforts (Chapters 1 – 4). This information will then be used to develop a TMDL for each pollutant of concern, if required, for the Upper Owyhee Watershed (Chapter 5).

1.1 Introduction

In 1972, Congress passed public law 92-500, the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Pollution Control Federation 1987). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The CWA has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to insure "swimmable and fishable" conditions. This goal, along with a 1972 goal to restore and maintain chemical, physical, and biological integrity, relates water quality with more than just chemistry.

Background

The federal government, through the U.S. Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the county. The Idaho Department of Environmental Quality (DEQ) implements the CWA in Idaho, while the EPA oversees Idaho and certifies the fulfillment of CWA requirements and responsibilities.

Section 303 of the CWA requires Idaho DEQ to adopt, with EPA approval, water quality standards and to review those standards every three years. Additionally, Idaho DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, Idaho DEQ must establish TMDLs for each pollutant impairing the waters. Further, the agency must set appropriate controls to restore water quality and allow the water bodies to meet their designated uses. These requirements result in a list of impaired waters, the "§303(d) list." This list describes water bodies not meeting water quality standards. Waters identified on this list require further analysis. A SBA and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the §303(d) list. The *Upper Owyhee Watershed Subbasin Assessment and Total Maximum Daily Load Owyhee County, Idaho* provides this summary for the currently listed waters in the Upper Owyhee Watershed.

The SBA section of this report (Chapters 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Upper Owyhee Watershed to date. While this assessment is not a requirement of the TMDL, Idaho DEQ performs the assessment to ensure impairment listings are up to date and accurate. The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (40 CFR § 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also includes individual pollutant allocations among various sources discharging the pollutant. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of specific pollutants as "pollution." TMDLs are not required for water bodies impaired by pollution, but not specific pollutants. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Idaho's Role

Idaho adopts water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

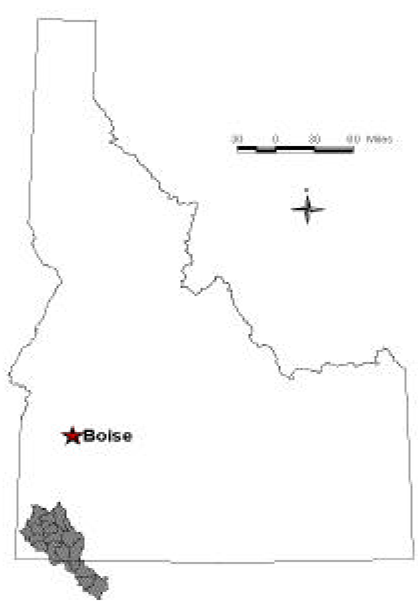
The state may assign or designate beneficial uses for particular Idaho water bodies to support. These beneficial uses are identified in the Idaho water quality standards and include:

- Aquatic life support – cold water, seasonal cold water, warm water, salmonid spawning, modified
- Contact recreation – primary (swimming), secondary (boating)
- Water supply – domestic, agricultural, industrial
- Wildlife habitats, aesthetics

The Idaho legislature designates uses for water bodies. Industrial water supply, wildlife habitat, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body is unclassified, then cold water and primary contact recreation are used as additional default designated uses when water bodies are assessed.

A SBA entails analyzing and integrating multiple types of water body data, such as biological, physical/chemical, and landscape data to address several objectives:

- Determine the degree of designated beneficial use support of the water body (i.e., attaining or not attaining water quality standards).
- Determine the degree of achievement of biological integrity.
- Compile descriptive information about the water body, particularly the identity and location of pollutant sources.
- When water bodies are not attaining water quality standards, determine the causes and extent of the impairment.



Upper Owyhee River Subbasin	
HUC#:	17050104
SWB#:	230
Streams:	Red Canyon Cr., Nickel Cr., Deep Cr., Pole Cr., Battle Cr., Castle Cr., Shoofly Cr.
Reservoirs:	Juniper Basin, Blue Creek
Pollution Sources:	Nonpoint Sources
Ecoregion:	Snake River-High Desert
Size (Total):	1,384,288 Acres
Size (Idaho):	1,012,411 Acres

Figure 1. Subbasin at a Glance. Upper Owyhee Watershed

1.2 Watershed Characteristics

The Upper Owyhee Subbasin, hydrologic unit code (HUC) 17050104, encompasses a large area in southwest Idaho and northern Nevada (Figure 2). The headwaters for the Owyhee River (East Fork) originate in northeast Nevada and the Independence Mountains. The Wild Horse Reservoir is a collection site for 2nd and 3rd order streams in the headwaters. Impoundment releases from the reservoir are governed by irrigation water demand and flood control. The East Fork Owyhee River then flows northwest through an incised canyon. After entering the Shoshone Paiute Indian Reservation, the valley bottom type broadens out into an alluvial depositional area and irrigated agriculture dominates the land use. Irrigation water is diverted from the East Fork Owyhee River at China Dam, a small in-river diversion, with a majority of irrigation waters diverted to the Duck Valley or Agency Canals. Irrigation water is either diverted out of the canals or from the East Fork Owyhee River for irrigating pasture and hayfields on tribal or private lands. Remaining irrigation water in the Duck Valley Canal is stored in the Sheep Creek Reservoir, which then irrigates agricultural areas in the South Fork Owyhee River drainage. The South Fork Owyhee River, in Idaho, had a SBA and TMDL completed in 1999 (Idaho DEQ 1999*a*). The East Fork Owyhee River flows into the state of Idaho at approximately river mile 79.4 (based on river miles from the South Fork of the Owyhee River), near China Dam. The river remains on tribal lands for another 13 miles.

To date, the Shoshone-Paiute Tribe has not listed any water quality limited segments within its tribal lands. Furthermore, the state of Idaho has not listed any water quality limited segments within tribal boundaries.

One Idaho §303(d) listed stream, Shoofly Creek, flows into Blue Creek, which enters tribal lands near the north boundary of the Reservation. However, Blue Creek is not a water quality limited segment (Idaho DEQ 1998).

After the river leaves tribal lands, it flows mostly westerly through deep canyons and the plateaus of the Owyhee-YP Desert. This area of Idaho is sparsely populated with most lands managed by the United States Department of Interior, Bureau of Land Management (BLM). Land use is mainly open rangeland, with some irrigated land on private holdings.

Although the East Fork Owyhee River is not listed as a water quality limited segment, three tributaries are (Idaho DEQ 1998). The other remaining §303(d) listed water bodies are tributaries to those water bodies, reservoirs, or are streams that are hydrologically connected to the East Fork Owyhee River. Further evaluation of the East Fork Owyhee River will be required utilizing the *Water Body Assessment Guidance* (Idaho DEQ 2000*b*) and the *Idaho River Ecological Assessment Framework* (Idaho DEQ 2000*c*). This document will not attempt to assess interstate or tribal water quality concerns. However, sediment allocation for one segment will establish a sediment reduction from the state of Nevada.

The water quality limited segments within the Upper Owyhee River Watershed were listed on Idaho's 1998 §303(d) list in response to litigation in Federal District Court. This litigation effort was based on concerns for the 1994 §303(d) list (Idaho DEQ 1994) and the 1988 *Idaho Water Quality Status Report and Nonpoint Source Assessment* (Idaho DEQ 1988). Table 1 describes the listed water quality limited segments (§303(d) listed streams), pollutants of concern, miles of streams listed, and possible beneficial uses impaired (Idaho DEQ 1998). Figure 3 shows the Upper Owyhee Watershed and the §303(d) listed segments.

Table 1. Idaho §303(d) listed Streams (Idaho DEQ 1998). Upper Owyhee Watershed.

Stream	Pollutants of Concern	Stream Miles	Impaired Uses
Blue Creek Reservoir	Sediment	185 Acres	CWAL[a], SS[b]
Juniper Basin Reservoir	Sediment	750 Acres	CWAL, SS
Deep Creek	Sediment, Temperature	46.1	CWAL, SS
Pole Creek	Sediment, Temperature, Flow Alteration	24.0	CWAL, SS
Castle Creek	Sediment, Temperature	11.5	CWAL, SS
Battle Creek	Bacteria	62.3	PCR[c]
Shoofly Creek	Bacteria	22.9	PCR
Red Canyon Creek	Sediment, Temperature, Flow Alteration	5.2	CWAL, SS
Nickel Creek	Sediment	2.8	CWAL, SS

a. Cold Water Aquatic Life; b. Salmonid Spawning; c. Primary Contact Recreation

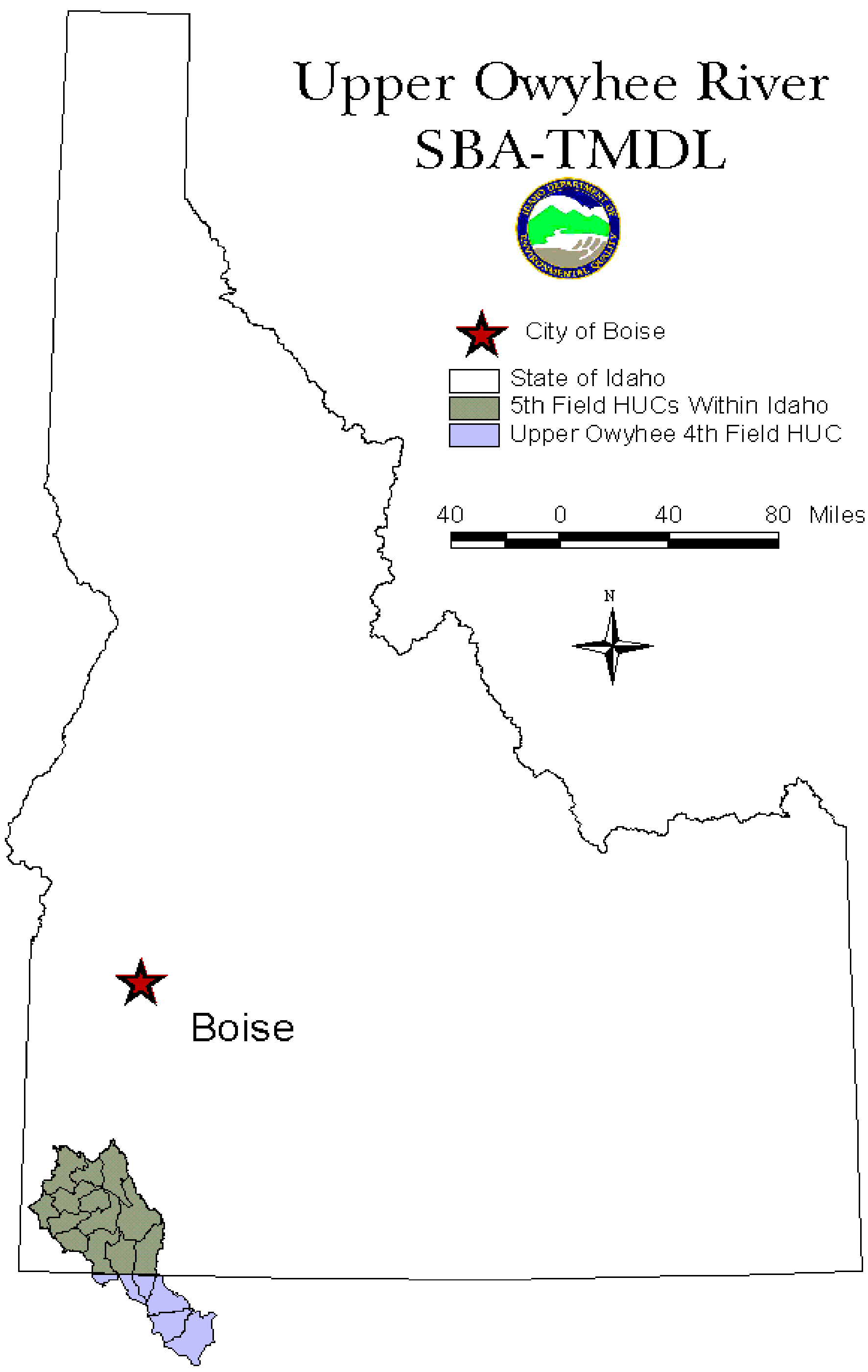


Figure 2. Upper Owyhee Watershed.

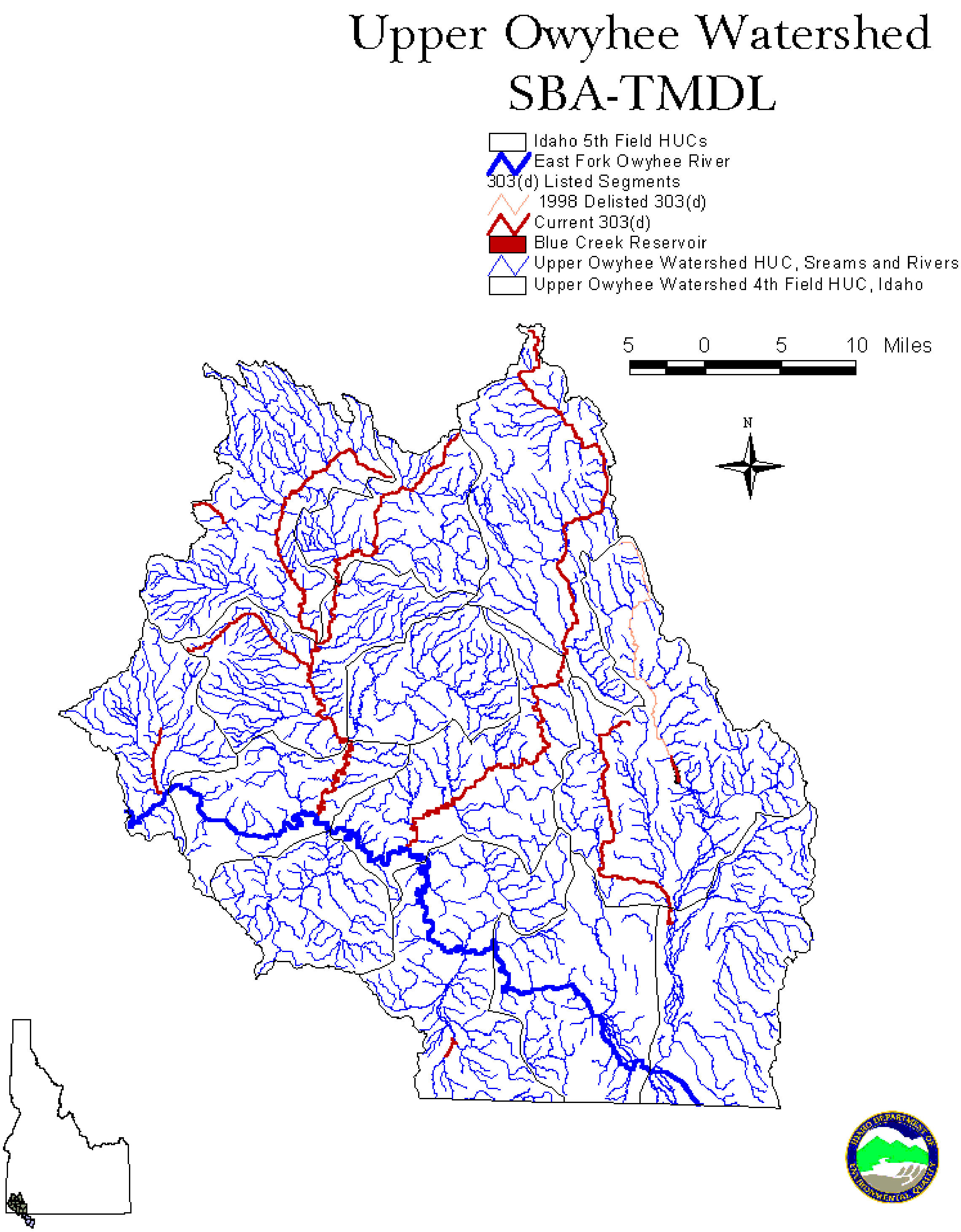


Figure 3. Streams, Rivers and §303(d) listed Segments. Upper Owyhee Watershed.

Fourth Field and Fifth Field HUCs

The upper Owyhee 4th field HUC spans two states, Idaho and Nevada, along with the Shoshone-Paiute Duck Valley Indian Reservation. Some related statistical data related to the entire Upper Owyhee Watershed 4th Field HUC is located in Appendix B. Table 2 describes the 5th field HUCs, with water quality limited segments that will be addressed in those HUCs, and drainage acres. Figure 4 shows 5th Field HUCs.

Table 2. 5th Field HUCs, Drainage Acres and Water Quality Limited §303(d) listed Segments. Upper Owyhee Watershed

5th Field HUC	State	§303(d) listed Segment	Drainage Acres
Upper Battle Creek	Idaho	Battle Creek	100,653
Hurry Back Creek	Idaho	Deep Creek, Nickel Creek	98,405
Pole Creek	Idaho	Pole Creek	54,550
Blue Creek Reservoir	Idaho	Blue Creek Reservoir, Shoofly Creek	136,477
Deep Creek	Idaho	Deep Creek, Castle Creek	71,598
Dickshooter Creek	Idaho	NA	49,010
Lower Battle Creek	Idaho	Battle Creek	82,525
Red Canyon	Idaho	Red Canyon Creek	49,898
Lower Owyhee River	Idaho	NA	53,428
Blue Creek	Idaho/Tribe	Shoofly Creek	129,460
Yatahoney Creek	Idaho/Tribe/Nev.	Juniper Basin Reservoir	107,994
Paiute Creek	Idaho	NA	50,634
Ross Lake	Idaho/Tribe/Nev.	NA	110,009
Middle Owyhee River	Tribe/Nevada	NA	84,058
Upper Owyhee River	Tribe/Nevada	NA	76,672
Wild Horse Reservoir	Tribe/Nevada	NA	128,917
		Total Acres (includes portions in Nevada)	1,384,288

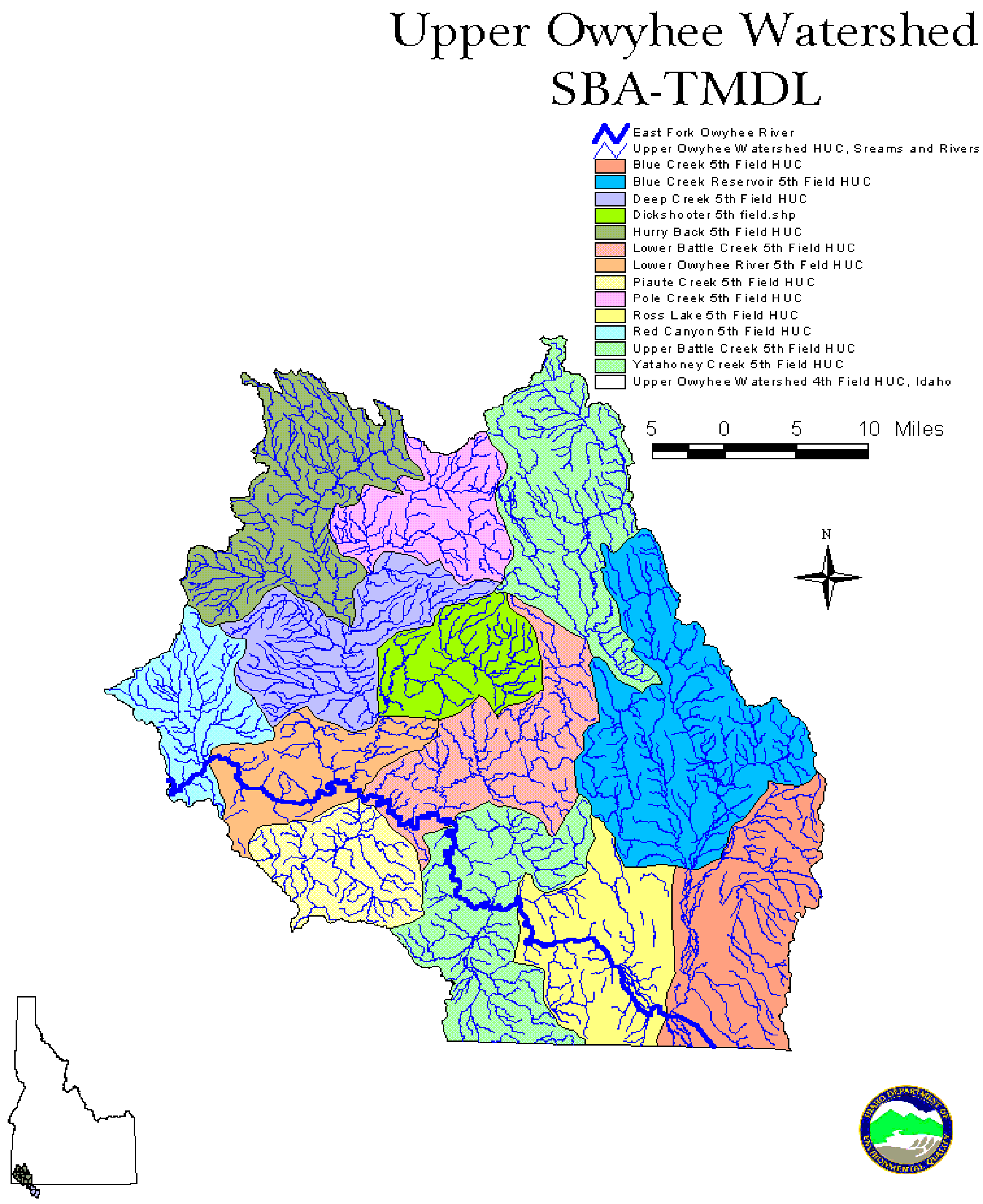


Figure 4. 5th Field HUCs. Upper Owyhee Watershed

Climate

There is one climate monitoring station within the Upper Owyhee Watershed: Owyhee, Nevada Station # 265869 (Climatic Service Center, Internet Retrieval 2001). Other stations within the immediate area are listed in Table 3. The three stations outside the watershed that most closely reflect expected weather conditions in the Upper Owyhee River Watershed are McDermitt, Nevada (Elevation 1390 meters, 4560 feet); Danner, Oregon (Elevation 1320 meters, 4330 feet); and Paradise Valley Ranches, Nevada (Elevation 1460 meters, 4790 feet) (Western Regional Climate Center 1999). Juniper Mountain is the highest elevation within the watershed at approximately 2090 meters (6857 feet). The lowest elevation is located at the confluence of the East Fork Owyhee River and the South Fork Owyhee River at approximately 1250 meters (4100 feet).

The canyons and plateaus of the East Fork Owyhee River, Battle Creek, Red Canyon Creek and Deep Creek likely receive between 9 and 11 inches of precipitation annually. There is probably not a permanent wintertime snow accumulation below 1400 meters (4593 feet) elevation (canyons or lower plateaus). However, Juniper Mountain and the Owyhee Mountains accumulate substantial snowfall during the winter (SNOTEL Sites: Mudflats Site #654 and South Mountain Site # 774, 2001)(NRCS 2001a).

Temperatures average 26-29 ^{o}C (80-85 ^{o}F) during summer months, but in all likelihood exceed 37 ^{o}C (100 ^{o}F) on occasion during June, July and August. Overnight temperatures in the canyon areas may be affected by several factors. “Cold pooling” may result in pockets of cool air. Drainage winds may also cause mixing and create warmer air. Sheltered areas may also have areas that maintain higher temperatures from daily heating due to surrounding igneous geology.

The plateaus and the Juniper Mountain area are more subject to gradient winds, daytime heating and nighttime cooling. These higher elevations are also more subject to summertime thunderstorms. As warm thermal air rises from northern Nevada and is rapidly cooled as it ascends up mountain slopes, summertime thunderstorms are sometimes produced.

Table 3. Climatic Summary, Available Weather Information (Western Regional Climatic Center 1999). Upper Owyhee Watershed.

Station and Station Identification	Paradise Valley, Nevada[a] (266005)	Three Creeks, Idaho[b] (109119)	Danner, Oregon[c] (352135)	Owyhee, Nevada[d] (265869)	McDermitt, Nevada[e] (264935)
Elevation meters (feet)	1460 (4790)	1690 (5544)	1320 (4330)	1690 (5544)	1390 (4560)
Max Average Temp, June-thru September (in $^oF/^oC$)	84.7/29.3	80.1/26.7	83.5/28.6	78.9/26.1	83.4/28.6
Min Average Temp, June thru September (in $^oF/^oC$)	43.7/6.5	38.1/3.4	43.0/6.1	46.4/8.0	43.2/6.2
Average Precip. (inches)	10.1	12.9	11.6	14.6	9.6
Average Snow accumulation (inches)	28.9	73.1	25.2	69.1	9.0

a.Period of Record 1948 through 1998, b. Period of Record 1940 through 1987, c.Period of Record 1930 through 1998, d.Period of Record 1948 through 1985, e.Period of Record 1950 through 1998.

Hydrology/Morphology

Most of the Idaho §303(d) listed streams in the Upper Owyhee Watershed flow north to south. Deep, Nickel, Pole and Battle Creeks all originate in the Antelope/Combination Ridge areas of the Owyhee Mountains. Castle and Red Canyon Creeks originate in the Juniper Mountain area and are fed by numerous 1st and 2nd order streams. Terrain in the upper watersheds (1st and 2nd order streams) is steep with the larger order streams (3rd, 4th and 5th) flowing into wet meadows, plateau areas and the incised canyons of the YP Desert. Shoofly Creek, the only stream outside the Owyhee Mountain area, originates in the rolling hills north of the tribal lands of the Duck Valley Indian Reservation. The main characteristic of this area is wide valley bottom types. Figure 5 shows the overall hydrology of the entire Upper Owyhee Watershed. Appendix B provides statistics and maps of individual 5th field HUC watersheds.

Juniper Basin and Blue Creek Reservoirs are located in the Yatahoney and Blue Creek Reservoir 5th field HUCs, respectively. Both dams are earthen structures. Juniper Basin Reservoir constructed in 1923 (IDWR 1971), was designed as a storage reservoir for irrigation water. It has since fallen into disrepair. The reservoir is mainly used for livestock watering. The dam is privately owned, but is entirely on lands managed by the BLM (IDWR 1971). See photos in Appendix E. The Idaho Department of Transportation 1:100,000 scale map (Riddle) shows a stagnate elevation of the reservoir at 1537 meters (5042 feet), with the total capacity at 1540 meters (5052 feet). It is calculated at the stagnate elevation the reservoir size is approximately 750 acres. At full capacity, the reservoir area doubles. The maximum depth is approximately 5 meters (16 feet), with a stagnate elevation depth of 2 meters (6.5 feet). The storage capacity is 500 acre feet (IDWR 1971). The Juniper Basin Reservoir Watershed is approximately 20,000 acres, with some of the headwaters located in Nevada. Waters flowing into the reservoir are intermittent and ephemeral.

Blue Creek Reservoir was constructed in 1935 and is privately owned, but is entirely on lands managed by the BLM (IDWR 1971). The dam is used to govern flow into Blue Creek and supplies irrigation water to the agricultural areas downstream. Releases from the reservoir are made into the Blue Creek channel at the base of the dam. Irrigation water is then removed from the creek at small diversion structures. The elevation of the reservoir is 1648 meters (5407 feet). The total reservoir size is approximately 185 acres; maximum depth is approximately 8 meters (26 feet). Water depth and reservoir size can fluctuate due to irrigation water demand. The storage capacity is listed at 250 acre feet (IDWR 1971). The 5th field Blue Creek Reservoir HUC encompasses approximately 107,000 acres. The watershed above the reservoir is approximately 30,000 acres. Blue Creek above the reservoir is usually perennial. However, in 2001, the creek was dry directly above the reservoir. Although the Idaho Department of Fish and Game (IDFG) had planted domestic Kamloops trout in the reservoir, it is not known if a conservation pool has been established or if there is adequate habitat for fish reproduction (IDFG 2001b).

Historic flow data is lacking on any of the listed streams within the 4th field HUC number 17050104 in the state of Idaho. Within the state of Nevada there are five historic water flow data sites, all on the East Fork Owyhee River. All these sites are below the Wild Horse Reservoir and would not reflect unregulated flows.

During the last two monitoring seasons, 2000 and 2001, Pole Creek, Red Canyon Creek and Castle Creek have either dried up completely at established monitoring sites, or were intermittent as defined in the *State of Idaho Water Quality Standards and Wastewater Treatment Requirements* (WQS) (IDAPA§ 58.02.0107.07). Nickel Creek is spring fed, but goes dry upstream of the springs during summer months. There did not appear to be any difference in the flow levels in 2000 and 2001. Nickel Creek was not evaluated for flow below Mud Flat Road to the confluence of Deep Creek. Shoofly Creek dried up upstream of Bybee Reservoir, but remained flowing below the reservoir, mainly for irrigation purposes.

It is not certain if the streams mentioned above go dry annually or if this condition was caused by drought conditions that occurred in southwest Idaho over the last two years. Since there are no historic or permanent flow gages within the Idaho portion of the HUC, it is difficult to determine the frequency streams become dry.

Springs and seeps are present in all watersheds within the Upper Owyhee Watershed and appear to be mostly a product of the geological formations. Like Nickel Creek, springs are the main source of water for many of the streams. However, it is not known what effect the drought conditions of the last two years may have had on these springs. In previous drought conditions, many springs have gone dry after one or two years of extremely low snowpack. Many of the major springs are located at similar elevations between 1640 and 2030 meters (5380 and 6660 feet). Headwater springs in the Juniper Mountain area are consistently near 1900-2000 meters (6233-6562 feet) elevation.

Many of the headwater streams are B channel types (Rosgen 1996), which indicate higher gradient with a gravel or gravel-sand substrate. Some of the headwater streams flow through steep canyons with higher gradient and a boulder-cobble substrate. As the streams naturally incised into the parent geological material, the gradient lessened, the confinement increased and these streams formed into F channel types (Rosgen 1996). Aerial photos (BLM 24 ID-91-AC) show these confined channels have large gravel and sand bar formations at the inside and end meander points and at pool tailouts. The lower gradient C channel types (wet meadows) are also evident, but many of these streams have become incised due to some change in hydraulic function and have formed into F-G channel types (Rosgen 1996). Many of these systems now lack adequate access to the historic floodplain.

The incised old C channel type systems may or may not be associated with current land use practices. Many of the old channels and meanders are above the current stream elevation, indicating downcutting in recent history. This downcutting could be associated with natural conditions, but most likely began with the removal of beavers in the early 1800s. The removal of the beavers and the beaver dams changed the overall hydraulics of the systems. These beaver dams once played an important role in maintaining finer course material behind the dams. Once these dams failed, the streams started downcutting into the finer substrate until they met a more stable substrate. As these systems stabilized, access to the floodplain once again became important for stabilizing the streams and the streambanks. Current land use practices have complicated the situation by removing vegetation that assists in reducing stream water velocity and the deposition of fine sediment (Thomas et al. 1998 and Dupont 1999a).

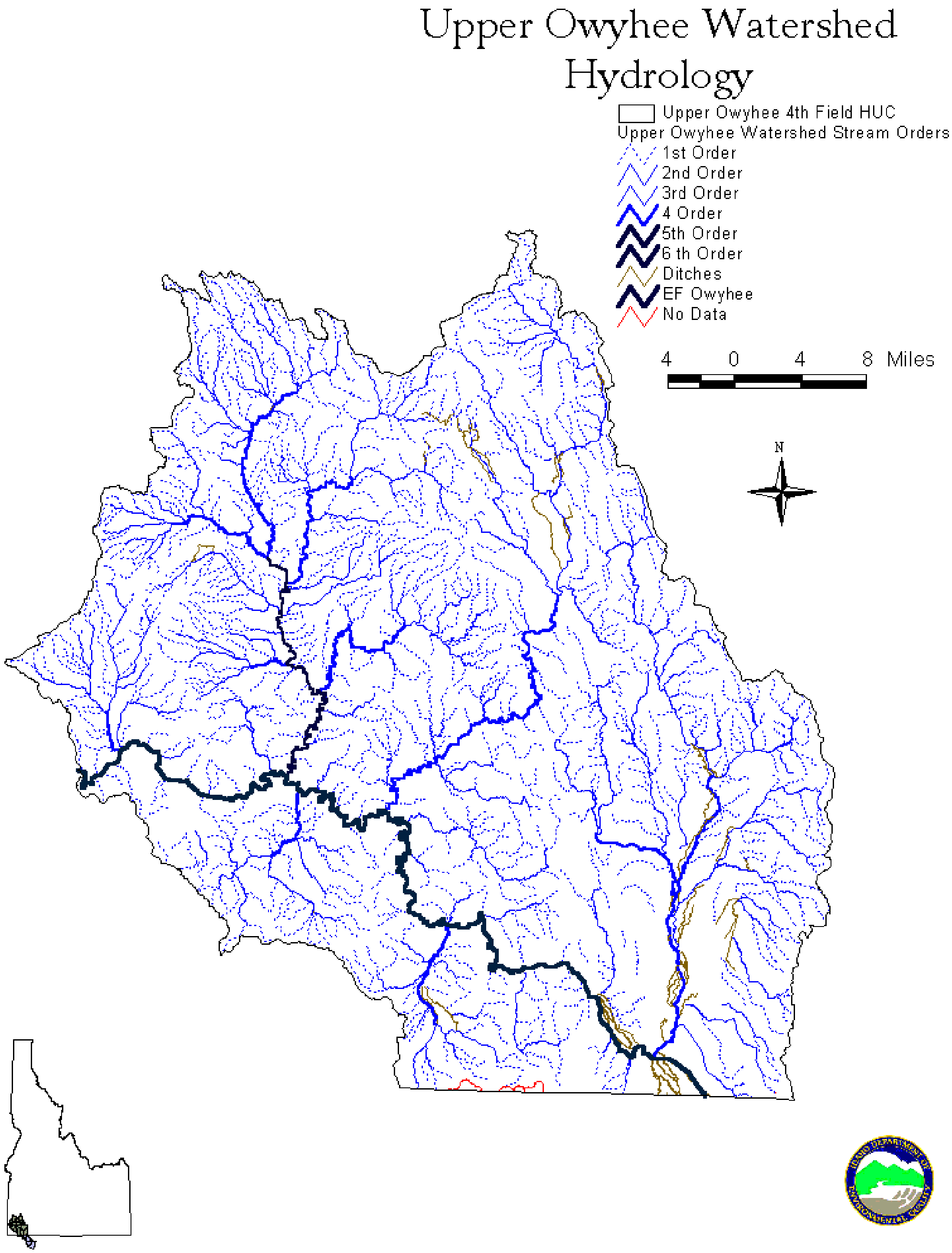


Figure 5. Overall Hydrology. Upper Owyhee Watershed

Geology/Soils

The Owyhee-YP Desert is composed of complex overlays of rhyolitic ash-flow tuffs, basalt flows and intercalated sedimentary rocks. The basement rocks, consisting of Mesozoic intrusive and metamorphic units, crop out within the Owyhee Mountains, which make up the northern boundary of the HUC. Most of the general characteristics of the local geology are due to past activity of Juniper Mountain, which is responsible for the rhyolitic ash-flow tuffs in the area approximately 8-11 million years ago (Minor et al. 1987, Swalan et al. 1987, Goeldner et al. 1987). Basalt flows can be seen in Castro Table, Little Point, Black Table, Lambart Table and Spring Butte.

It is these layers of the rhyolitic ash-flow tuffs, and their exposure, which make up the canyons of Deep Creek, Red Canyon Creek, and Battle Creek. The East Fork Owyhee River canyon is more associated with basalt-rhyolitic ash-flow tuffs flow activity from the Swisher Mountain flows (Swalan et al. 1987). These canyons are as deep as 300 meters (984 feet) in some locations.

Soils within the high plateau areas are a thin veneer of sediment from alluvial, fluvial, colluvium, ancient lakebeds and landslide sources. Soils are generally characterized as acidic/xeric or soil moisture regime and mesic frigid soil temperature regime. Soils are classified as silt loams to clay loams and range from shallow to deep. Rock fragments can be found scattered in the soil and within the soil profile. Figure 6 and Figure 7 show the overall geological formation and the soil profiles of the Upper Owyhee Watershed.

Stream sediment is mostly of alluvial origin. However, in steep canyon areas, large boulders can be found from landslides and talus slopes. In areas where stream gradient lessens, sandy or sandy-loam soils can be found. The depositional area in the larger streams is usually associated with flashy storm event flows or springtime flooding.

Smaller 3rd order stream (Castle Creek, Pole Creek) valley bottom types dictate stream morphology and near stream soils. In many areas the remnants of beaver dams can be seen, which would indicate stream channel buildup associated with the trapped sediment. As beavers were removed and dams failed, the streams cut down through the depositional areas of fine alluvial deposits (fine sediment and sands).

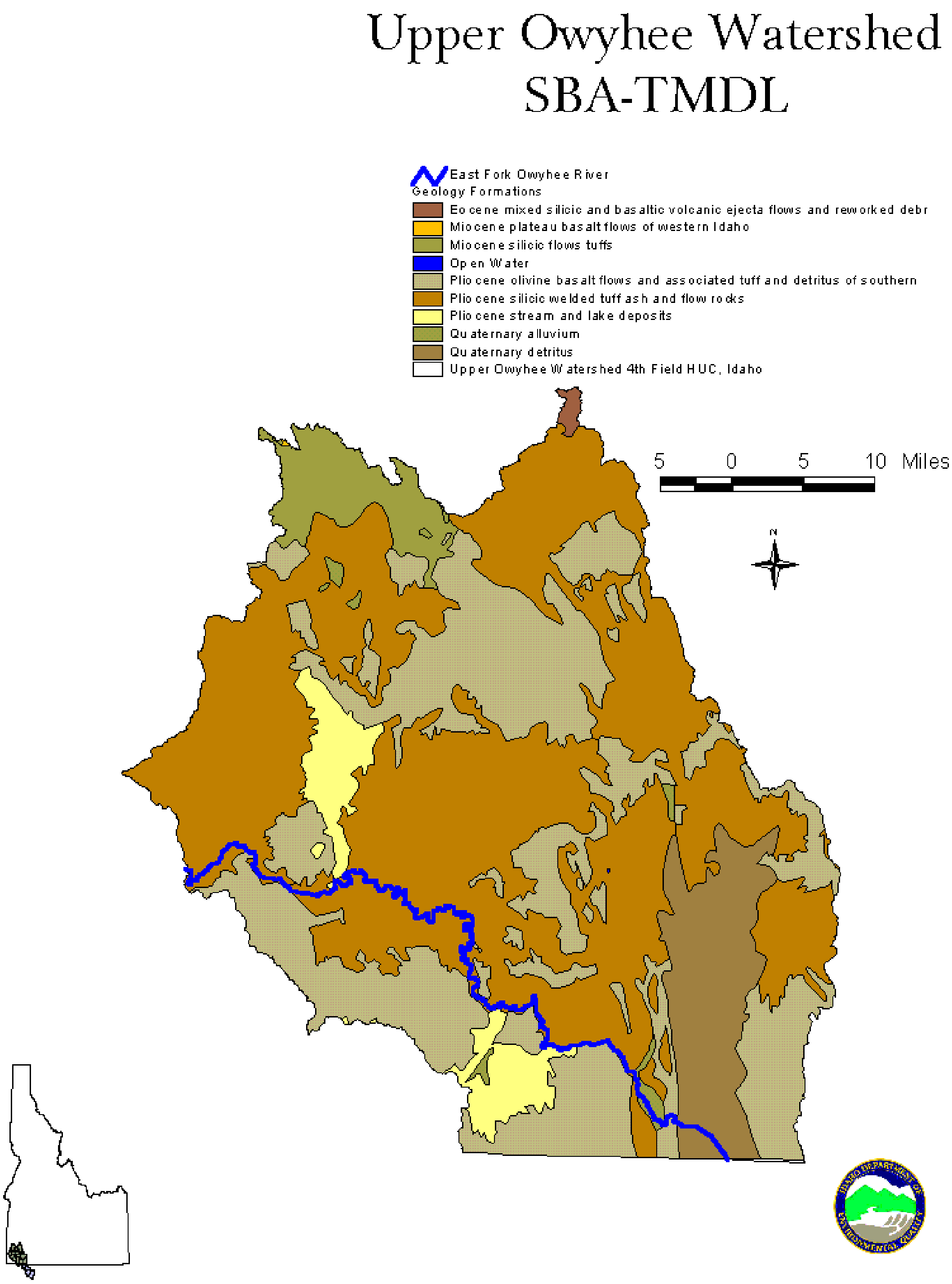


Figure 6. Geology. Upper Owyhee Watershed.

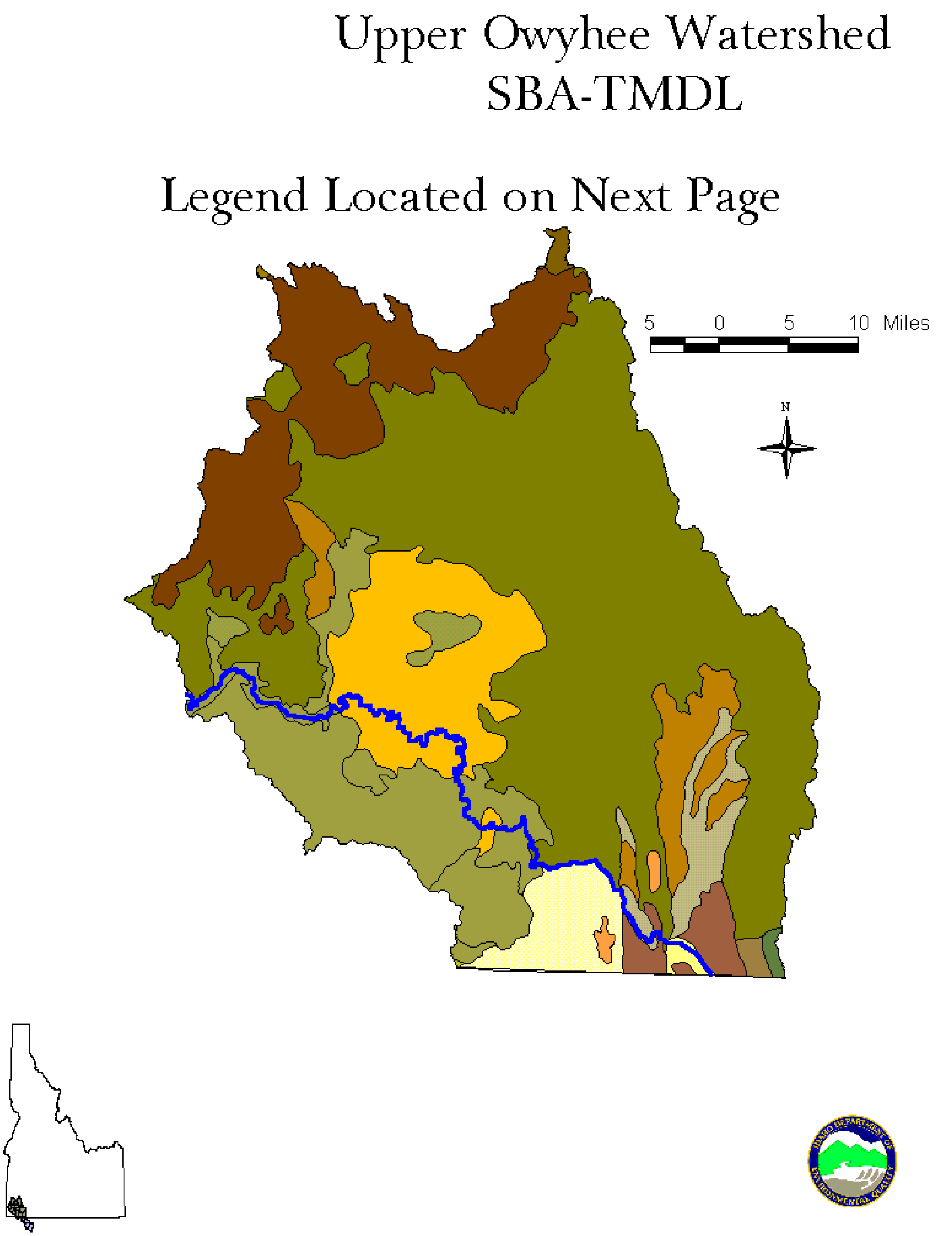


Figure 7. Soils. Upper Owyhee Watershed

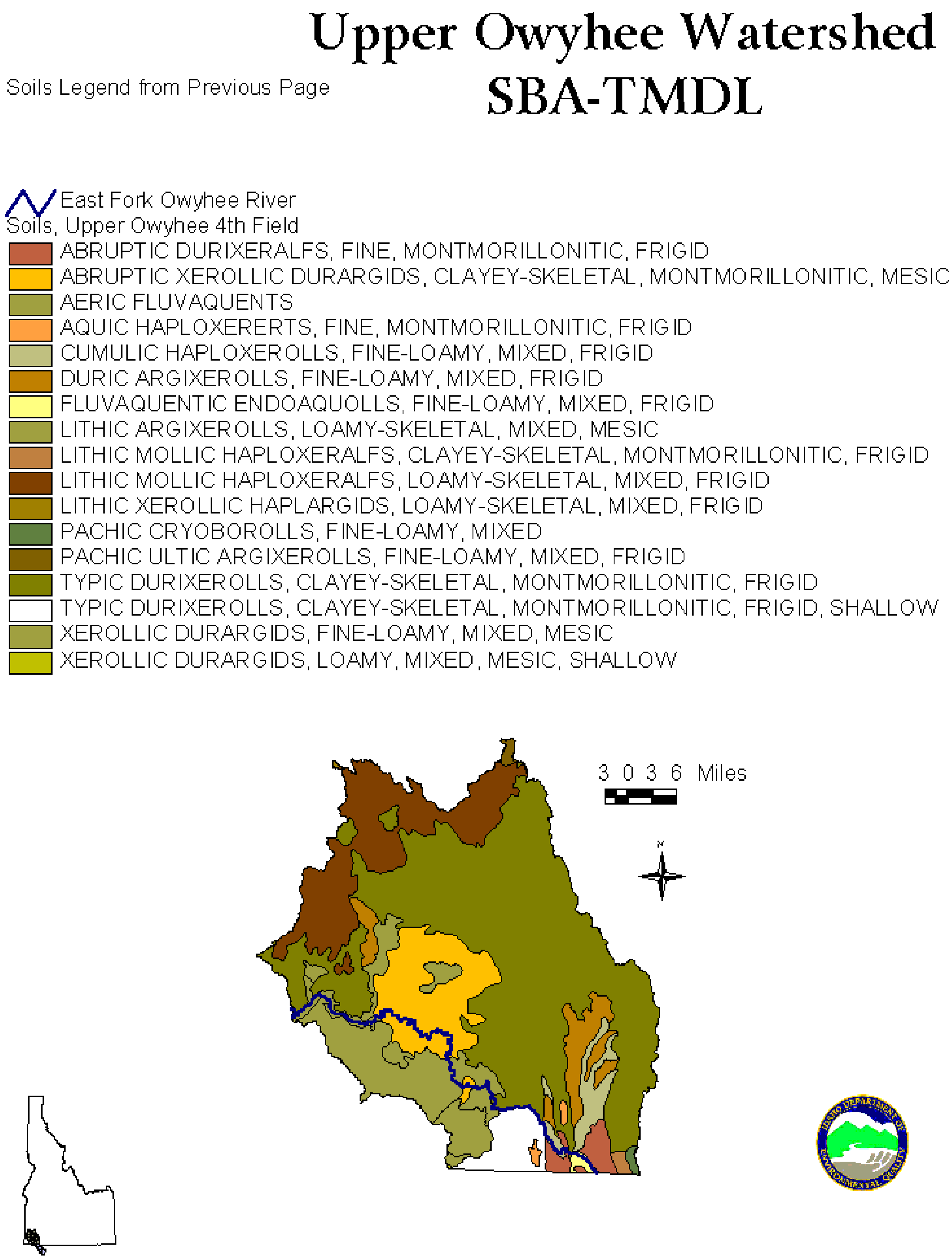


Figure 7. (Cont.) Soils. Upper Owyhee Watershed.

Biological Information

Endangered Species

The *Owyhee Resource Management Plan and Final Environmental Impact Statement* (ORMP) (BLM 1999) has listed 31 species of plants that are "special status plants" and 50 animal species that are classified as "special status animal species." These plants and animals may be endangered, threatened, candidate for listing, state endangered, state species of special concern, or BLM sensitive species. Only one plant, Ute ladies' tresses (*Spiranthes diluvialis*) is listed as threatened, and no endangered plant species are listed in the Upper Owyhee Watershed. For animals, only the bald eagle (*Haliaeetus leuococephalus*), peregrine falcon (*Falco mexicanus*) and the gray wolf (*Canus lupus*) are listed as threatened or endangered. There are numerous state species of special concern including redband trout (*Oncorhynchus mykiss gairdeneri*), which can be found in streams in the Upper Owyhee Watershed (USDI-BLM 1999). There are no federally listed endangered fish species associated with the Upper Owyhee Watershed (BLM 1999). Although this list of special status plants and animals species originated from ORMP, which applies to areas west of Deep Creek, it is assumed that species composition and communities are similar in eastern areas of the watershed.

Plant Communities

As seen in Table 4, rangeland makes up the largest portion of land use in the Upper Owyhee Watershed. The majority of these areas are the sagebrush steppe ecosystem, with low sagebrush (*Artemisia arbuscula*) communities dominating most of the lower elevations of the YP-JP Desert. Most of these areas are associated with flat sage covered plateaus split by deep canyons. Mountain big sagebrush (*Artemisia tridentata*) communities can be found in higher wetter elevations and north slopes. Understory communities are naturally assorted Idaho fescue (*Festucae idahoenis*), bunchgrass and bluegrass (*Poa sp.*). In some areas, cheatgrass has invaded the area.

Western juniper (*Juniperus occidentalis*) has invaded into areas that in the past were dominated by either mountain big sagebrush or low sagebrush communities. Only a small portion of the Upper Owyhee Watershed would be classified as having western juniper as the potential climax species (BLM 1999). This invasion and the subsequent depletion of sage/grass lands can be associated with the current land use, frequency of fire and possible climatic changes (Bedell et al. 1991).

Riparian areas are areas of vegetation growing along stream/river corridors. Riparian areas are made of a complex vegetation structure of herbaceous or woody species, and are valuable for biodiversity. Woody species could include willow (*Salix sp.*), cottonwoods (*Populus sp.*), alders (*Alnus sp.*), aspen (*Populus sp.)*, and dogwood (*Cornus sp.*). Herbaceous species may include rushes (*Juncus sp.*), sedges (*Carex sp.*) spiked rushes (*Eleocharis sp.*), and other mixed Gramineae species, both hydrophilic and hydrophobic.

Past and current land use has altered the vegetation composition of many of the riparian and upland areas. As streams down-cut and become incised there is a loss of access to historic floodplains; shallow near stream ground water storage is also lost (Thomas et al. 1998). This has brought on an invasion of hydrophobic species, including western juniper, almost to the water's edge. This invasion and presence of hydrophobic species on Red Canyon Creek and upper elevation reaches of Deep Creek and Pole Creek are most notable. In the uplands, non-native grasses such as cheat grass (*Bromus sp.*) has invaded into areas following a disturbance such as wildfire.

In low stream gradient areas, some of the old wet meadow riparian areas may have been converted to irrigated pasture or hay fields. This has altered the composition of native species. Introduced herbaceous species such as brome grass (*Bromus sp*.), Timothy grass (*Phleum sp*.), redd canary grass (*Phalaris sp*.), tall wheat grass (*Agropyron sp*.), orchard grass (*Dactylis sp*.), rye grasses (*Elymus sp*.) and other nonnative species may now dominate some of these areas.

Fisheries

There is evidence of the prehistoric presence of anadromous fish in the Upper Owyhee Watershed and the East Fork Owyhee River (Plew 1985). During an archaeological dig near Pole Creek, the remains of a steelhead trout were located in the Nahas Cave. This may indicate prehistoric anadromous spawning in the smaller tributaries such as Deep Creek, Pole Creek and other 3rd or 4th order streams in the Upper Owyhee Watershed. Anadromous fish are no longer present due to impassable barriers downstream on the Owyhee River in Oregon and other barriers on the Snake River.

Although current fish data are limited, there are some studies that have occurred in the Owyhee County area. Some of these studies either involved the actual capture of fish; others involved personal observations. Allen, et al. (1993, 1995, 1996, 1997 and 1998) has provided documentation of the presence of a variety of species found in the Owyhee Desert. Allen inventoried smallmouth bass (*Micropterus dolomieui)*, sculpins (*Cottus sp.*), bridgelip suckers (*Catostomus columbianus*), mountain sucker (*Catostomun platyrhynchus*), chiselmouth (Acrocheilus *alutaceus*), mountain whitefish (*Prosopium williamsoni*), redside shiners (*Richardsonius balteatus*), speckled dace (*Rhinichthys osculus*), longnose dace (*Rhinichthys cataractae*), northern pikeminnows (*Ptychoccheilus oregonenis*), largescale suckers (*Catostomus macrocheilus)*, and redband trout (*Oncorhynchus mykiss gairdeneri*). Only redband trout and mountain whitefish are classified as salmonid species.

The ORMP goes into some detail on the presence of redband trout within some portions of the Upper Owyhee Watershed. Although limited to Castle Creek, Deep Creek, Nip and Tuck Creek and Red Canyon Creek, the ORMP does indicate the presence of the species in most water bodies in the Upper Owyhee Watershed. The ORMP concentrated the evaluation effort on those water bodies to the west of Deep Creek.

Recent collection efforts by the BLM in Deep Creek, Pole Creek, Castle Creek, Camas Creek, Battle Creek and Nickel Creek have shown similar to those of Allen (Zoellick 2001). Few redband trout were counted in the 2000 BLM electrofishing effort, and no young of the year were documented. The BLM has not organized all fishery data from the 2000 collection effort, and there is still some evaluation occurring.

The IDFG did not provide any information on recent studies completed in the Upper Owyhee Watershed. Except for the fish stocking in Blue Creek Reservoir, there is no other evidence any other stocking effort has occurred in the Upper Owyhee Watershed. It should be noted that the *2001-2006 Fisheries Management Plan* lists all streams in the Upper Owyhee Watershed to be managed for mixed fisheries, except for Deep Creek, Battle Creek and Blue Creek (IDFG 2001b). These streams and their tributaries are to be managed for wild redband trout. Mixed fisheries is defined as those waters that support a combination of cold water and warm water species (IDFG 2001b).

The designation of Deep Creek, Battle Creek and Blue Creek for management of wild redband trout is interpreted as a management plan for desirable species, including the self propagation of desirable species. The state WQS specifically state that "wherever attainable, surface waters of the state shall be protected for beneficial uses which for surface waters includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic life (IDAPA§ 58.01.02.050.02.a)." The state WQS also state "In all cases, existing beneficial uses of the waters of the state will be protected" (IDAPA§ 58.01.02.050.02.a).

A search of the Idaho DEQ Beneficial Use Reconnaissance Program (BURP) database provided some additional information on fisheries. Electrofishing had occurred on four sites in 1995 and 1996. (BURP ID#1995SBOIB010 [Deep Creek Lower], BURP ID#1995SBOIB012 [Deep Creek Upper], BURP ID#1995SBOIB014 [Pole Creek], and BURP ID# 1996SBOI019 [Castle Creek]).

Results from the BURP effort showed mostly nongame species of bridgelip suckers (*Catostomus columbianus*), redside shiners (*Richardsonius balteatus*), chiselmouth, (*Acrocheilus alutaceus*), northern pike minnows (*Ptychoccheilus oregonenis*), largescale suckers (*Catostomus macrocheilus*), speckled dace (*Rhinichthys osculus*), longnose dace (*Rhinichthys cataractae*), and sculpin (*Cottus sp.*). Smallmouth bass (*Micropterus dolomieui*) was the only game species recovered. No redband trout were found during the BURP fish monitoring effort.

Benthic (Benthos) Communities

Benthic communities are references to any living organisms that can be found on the bed (substrate) of streams or any other water body. The benthic community can consist of insects (macroinvertebrates), worms (Oligochaeta), algae (periphyton), vascular plants (macrophytes), or any other living organisms (bacteria, fungi, etc.).

The BURP sampling has focused mainly on macroinvertebrates as indicators of support of beneficial uses, mainly cold water aquatic life (CWAL). BURP data for streams in the Upper Owyhee Watershed showed the macroinvertebrate community consisted of the orders of Diptera (flies), Odonata (dragonflies, damselflies), Coleoptera (beetles), Trichoptera (caddisflies), Ephemeroptera (mayflies) and Oligochaeta (worms). Some studies that have either focused on the Owyhee-YP Desert area or incorporated the area into a larger statewide evaluation can be found in Clark (1978), Clark (1979) and Robinson and Minshall (1994). Further analysis of macroinvertebrates is located in Section 2.3.

There were some collections and analyses of the algae communities in the Upper Owyhee Watershed. On the ten streams receiving analysis for periphyton, the average pollution tolerance index was 2.54. The pollution tolerance index is based on sets of metrics on species present in samples and if species are tolerant of certain types of pollutants. The pollution tolerant index of 2.54 indicates the streams are slightly to moderately impaired by pollutants. More discussion of periphyton results from 2000 and 2001 are located in Section 2.3.

1.3 Cultural Characteristics

<u>Past and Current Land Use</u>

Evidence shows the Upper Owyhee Watershed has a long history of use by prehistoric Native Americans. Documentation by Plew (1985) indicates use by the prehistoric population was year round, with winter camps associated with the lower elevations of the East Fork Owyhee River Canyon. Upper elevations were used for hunting and gathering camps (Pole Creek, Camas Creek) during summer and fall. Carbon dated material shows the area has been inhabited over the last 6000 years (Plew 1985).

The first historic Anglo-European presence was probably associated with the beaver trappers in the late 1700s. Although mostly a high-arid desert, the streams and rivers within the Upper Owyhee Watershed at one time supported a viable beaver population. Past beaver activity can be noted in many of the irrigated pasture areas where fine sediment deposits have created fertile soils areas along stream corridors. Although no current trapping records are available, there appears to be sparse beaver activity currently in the Upper Owyhee Watershed (Personal Observation, Ingham 2001)

It was not until 1863 that a permanent presence of Anglo-European is documented (Adams 1986). Mineral deposits of gold and silver were discovered in the Jordan Creek area of the Silver City Range of the Owyhee Mountains. The first documented settlement (mining camp) was Ruby City, located on Jordan Creek. Other mining camps and new discoveries of deposits of gold and silver soon followed. This area supported numerous towns and camps throughout the late 1800s and through the early 1900s (Adams 1986). As the gold and silver deposits were mined out, towns were abandoned. Silver City is the only permanent settlement remaining. Some mining still occurs in the area, with extraction of gold from low grade ore. There are two permanent incorporated communities in the Upper Owyhee Watershed, Owyhee and Mountain City, Nevada. Scattered homesteads can be found on Tribal lands in Idaho, but no communities.

As the mining towns and camps flourished, many who could not find their riches in mining turned to supporting the mining population. Sheep and cattle businesses began to operate soon after ore deposits were discovered. Along with the spring-summer-fall open grazing, these operations needed areas for hay production for winter feed. The stream corridors provided these areas.

Table 4 shows the breakdown of current land use practices in the Upper Owyhee Watershed. Figure 8 shows a map of current land use. Although forested areas make up 7.5% of the total land type in the Upper Owyhee, actual timber harvest for lumber is non-existent. Most of the woodland areas are western juniper (*Juniperus occidentalis*) which has little commercial value, except for rough fencing material or firewood. More discussion of plant communities and seral conditions can be found in section 1.2.

Rangeland in this area is mostly part of the intermountain sagebrush province/sagebrush steppe ecosystem (BLM 1999). The sagebrush steppe ecosystem is widespread throughout northern

Nevada, southeastern Oregon and southern Idaho. Riparian and irrigated areas are usually located within the historic floodplains of stream and river corridors.

Table 4. Land Use, Total Acres and Percent of Total Acres. Upper Owyhee Watershed.

Land Use	Acres/Percent
Rangeland	889,562 acres (88%)
Irrigated Gravity	1,493 acres (<1%)
Irrigated Sprinkler	2,396 acres (<1%)
Riparian	42,856 acres (4%)
Forested	76,108 acres (7.5%)
Total	1,012,415 acres (100%)

Land Ownership/Management

Almost 74% of all lands within the Upper Owyhee Watershed are managed by the BLM, and most of this land is devoted to rangeland. The Bureau of Indian Affairs (BIA) is the other large federal land manager. The Duck Valley Indian Reservation extends into northern Nevada, but encompasses about 122,375 acres of the Upper Owyhee Watershed within Idaho.

Private holdings are found mostly in the riparian areas and make up about 6.5% of all land ownership. These areas are usually the more productive areas and may or may not be irrigated. Many of these private holdings were once independent ranches, such as the Star Ranch, Brace Brother's Ranch and Castro Ranch, but many now have been grouped into grazing associations. Other smaller holdings have also been bought by large corporations and incorporated into much larger operations.

Table 5, shows the breakdown of land ownership/management. Figure 9 shows the schematic of land ownership/management patterns. Appendix B has a complete breakdown of ownership/management by 5th Field HUC.

Table 5. Land Ownership/Management, Acres and Percent of Total. Upper Owyhee Watershed.

Ownership/Management	Acres/Percent
Private	65,653 acres (6.5%)
State of Idaho	37,428 acres (7.3%)
Federal/Bureau of Land Management	746,833 acres (73.8%)
Tribal lands	122,375 acres (12.1%)
Open Water	4,117 acres (0.4%)
Total	1,012,406 acres (100%)

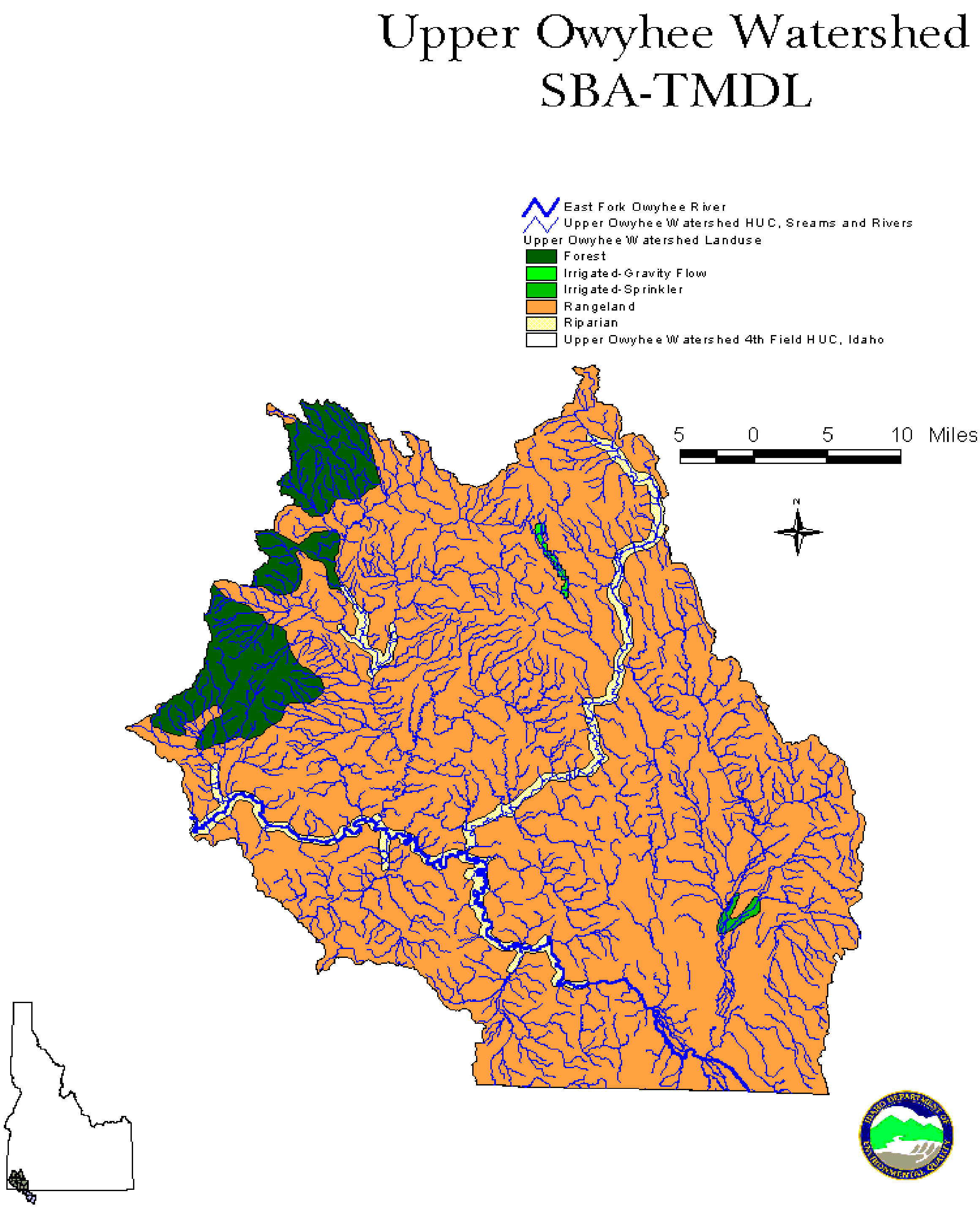


Figure 8. Land Use. Upper Owyhee Watershed.

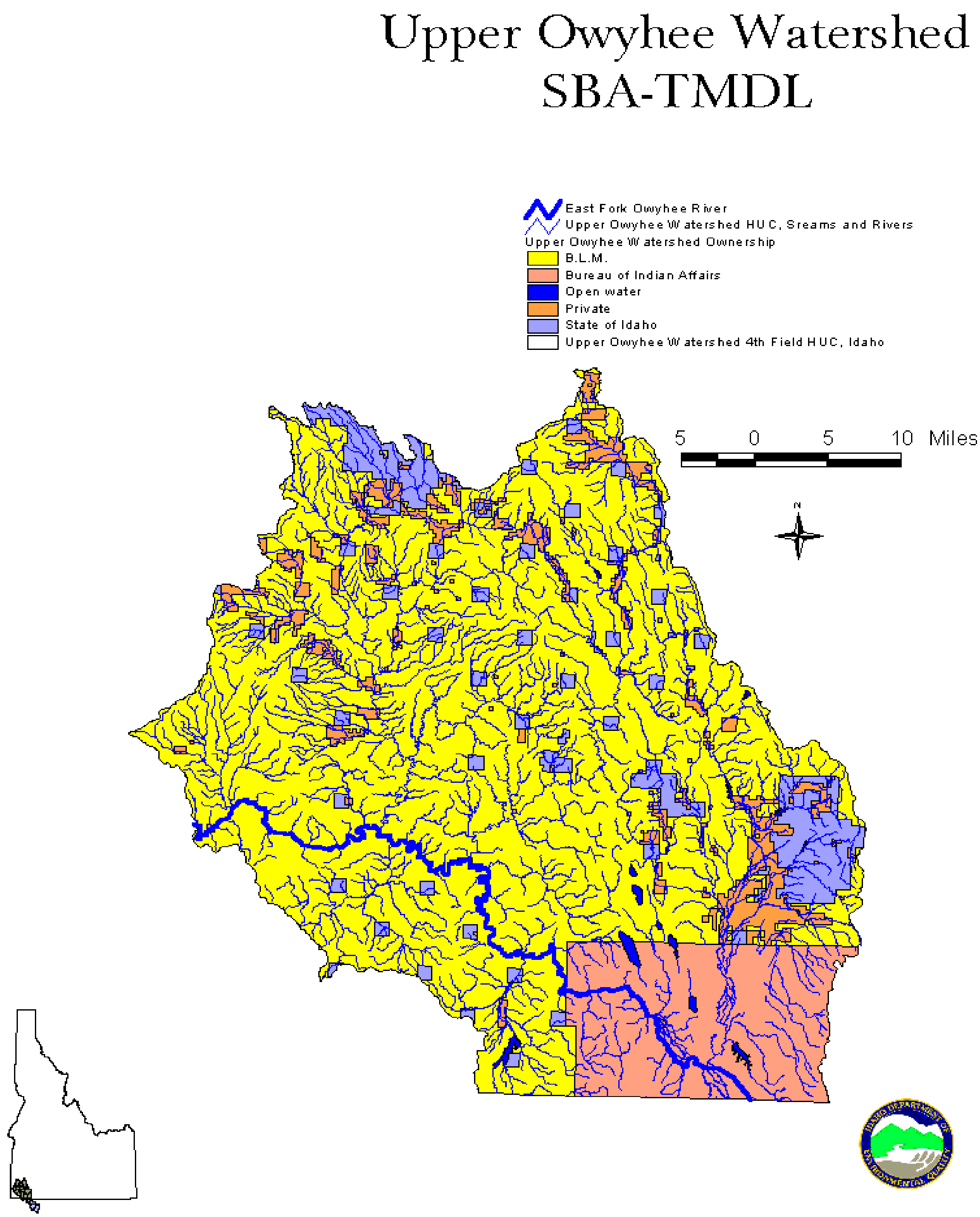


Figure 9. Land Ownership/Management. Upper Owyhee Watershed.

2. Subbasin Assessment – Water Quality Concerns and Status

2.1 Applicable Water Quality Standards

The State of Idaho *Water Quality Standards and Wastewater Treatment Requirements* (WQS), IDAPA§ 58.01.02 define the water quality goals of water bodies by designating uses and establishing numeric and narrative standards (ambient conditions) necessary to protect the designated and existing uses. Existing uses are those surface water uses actually attained on or after November 28, 1975, whether or not they are designated uses. Those water bodies not identified with a designated use will be protected for existing uses.

All waters are protected through the general surface water quality criteria. A narrative standard prohibits certain pollutants or conditions, which may impair designated or existing uses. For the state of Idaho, these pollutants include: hazardous materials; toxic substances; deleterious materials; radioactive materials; floating, suspended or submerged matter; excess nutrients; oxygen demanding materials; and sediment (IDAPA§ 58.01.02.200). Numeric standards for the support of designated uses and/or existing uses are set in IDAPA§ 58.01.02.250. The criteria include temperature, dissolved oxygen, bacteria counts and other values set to protect beneficial uses.

Aquatic Life

CWAL is a designated beneficial use for Red Canyon Creek (IDAPA§ 58.01.02.140.01.SW-34). There are numeric and narrative criteria within the state WQS to protect CWAL. Numeric standards for pH, total concentration of dissolved gases, toxic substances and chlorine can be found in IDAPA§ 58.01.02.250.02. Other standards specific to CWAL (dissolved oxygen, un-ionized ammonia, turbidity; and temperature) are located in IDAPA§ 58.01.02.250.02.c.

If the water body does not have CWAL as a designated use, but it can be determined CWAL is an existing use, then the numeric and narrative standards for the protection of CWAL apply. In the WQS, it is presumed that all waters of the state have CWAL as an existing use. It is through the SBA process that Idaho DEQ determines if CWAL is actually an existing use, or if other aquatic life is existing. If it is determined CWAL is not an existing use, then the water body will be assessed to determine if another aquatic life use exists (IDAPA§ 58.01.02.100.01).

Salmonid spawning is not a designated beneficial use for any listed water body within the Upper Owyhee Watershed (IDAPA§ 58.02.140.01). If it is determined through the SBA process that salmonid spawning is an existing use, then the criteria for the protection of salmonid spawning are applied. Criteria for the protection of salmonid spawning are listed under IDAPA§ 58.01.02.250.01. Numeric standards for pH, total dissolved gas, toxic substances and chlorine are specified in the WQS (IDAPA§ 58.01.02.250.01.). Other standards specific to salmonid spawning (dissolved oxygen, un-ionized ammonia, intergravel dissolved oxygen, and temperature) are located in IDAPA§ 58.01.02.250.02.e. The normal spawning period for salmonid species in the Upper Owyhee Watershed (redband trout) is March 1 through July 15.

Recreational Uses

All waters of the state are to be protected for primary contact recreation (PCR). However, if the water body cannot physically support PCR (i.e., lack of depth, lack of adequate flow, etc.) then secondary contact recreation (SCR) becomes the protected recreational use. The WQS (IDAPA§ 58.02.01.250.1) provide numeric criteria to determine support of both PCR and SCR.

The WQS (IDAPA§ 58.02.01.100.02.a. and b.) states the following for PCR and SCR:

> Primary Contact Recreation (PCR): water quality appropriate for prolonged and intimate contact by humans or for recreational activities when the ingestion of small quantities of water is likely to occur. Such activities include, but are not restricted to, those used for swimming, water skiing, or skin diving.
>
> Secondary contact recreation (SCR): water quality appropriate for recreational uses on or about the water and which are not included in the primary contact category. These activities may include fishing, boating, wading, infrequent swimming and other activities where ingestion of raw water is not likely to occur.

Agricultural Water Supply

Most waters of the state are protected for agricultural water supply (IDAPA§ 58.01.02.100.03.b.). In the WQS this is defined as, “Agricultural waters which are suitable for the irrigation of crops or as drinking water for livestock.”

Agricultural water supply can be impaired by nutrients, bacteria (along with viruses and protozoa), algae, sediment, flow modification, and other conditions that may affect the quality and quantity of water. There are no numeric state standards to determine support status. However, under IDAPA§ 58.01.02.200 agricultural water supply is protected under the general surface water quality criteria. *Water Quality Criteria 1972* (Blue Book), Section V, Agricultural Uses of Water (EPA 1973) will be used for determining criteria. Historical and current water quality information has demonstrated agricultural water supply is an existing use and is fully supported in the Upper Owyhee Watershed.

Domestic Water Supply

Domestic water supply is not a designated beneficial use for any §303(d) listed water bodies in the Upper Owyhee Watershed (IDAPA§ 58.01.02.140.01.). Domestic water supply is defined as water that is potable after treatment. There are no domestic water supplies within the watershed. Therefore, domestic water supply is not an existing use. The East Fork Owyhee River is designated for drinking water supply. However, there are no known withdrawals for this use.

Industrial Water Supply

All waters of the state, including the Upper Owyhee Watershed, are protected for industrial water supply (IDAPA§ 58.01.02.100.03.c). There are no numeric standards to determine support status.

However, under IDAPA§ 58.01.02.200 industrial water supply is protected under the general surface water quality criteria. Historical and present water quality information have not demonstrated industrial water supply as an existing use nor it is an impaired use.

Wildlife Habitat

All waters of the state, including the Upper Owyhee Watershed, are protected for wildlife habitat (IDAPA§ 58.01.02.100.04.). There are no numeric state standards to determine support status. However, under IDAPA§ 58.01.02.200 wildlife habitat is protected under the general surface water quality criteria. Historical and present water quality information demonstrate wildlife habitat is supported in the Upper Owyhee Watershed.

Aesthetics

All waters of the state, including the Upper Owyhee Watershed, are protected for aesthetics. There are no numeric state standards to determine support status. However, under IDAPA§ 58.01.02.200 aesthetics are protected under the general surface water quality criteria. Idaho DEQ has not received any formal complaints concerning water bodies and the aesthetic quality of the Upper Owyhee Watershed.

2.2 Designated Uses

Red Canyon Creek is the only §303(d) listed stream with designated beneficial uses set forth in the state of Idaho WQS. The WQS have listed both CWAL and PCR as designated uses (IDAPA§ 58.01.02.140.04 SW-34). Although not directly listed in IDAPA§ 58.01.02.140.04 SW-34, other designated uses include agricultural water supply, industrial water supply, wildlife habitat and aesthetics (IDAPA§ 58.01.02.100.03(a)(b)(c), IDAPA§ 58.01.02.100.04 and IDAPA§ 58.01.02.100.05). Table 6 describes the designated uses on the Idaho §303(d) listed in the Upper Owyhee Watershed.

Table 6. Designated Beneficial Uses. Upper Owyhee Watershed.

Water Body	Designated Uses[a]	1998 §303(d) list[b]
Blue Creek Reservoir	AWS, IDS, AS, WLH	
Juniper Basin Reservoir	AWS, IDS, AS, WLH	
Deep Creek	AWS, IDS, AS, WLH	
Pole Creek	AWS, IDS, AS, WLH	
Castle Creek	AWS, IDS, AS, WLH	
Battle Creek	AWS, IDS, AS, WLH	
Shoofly Creek	AWS, IDS, AS, WLH	
Red Canyon Creek	CWAL, PCR, AWS, IDS, AS, WLH	
Nickel Creek	AWS, IDS, AS, WLH	

a CWAL – Cold Water Aquatic Life, PCR – Primary Contact Recreation, AWS – Agricultural Water Supply, IDS-Industrial Water Supply, AS-aesthetics, WLH-Wildlife Habitat

b. Refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection “d” of the Clean Water Act.

2.3 Existing Beneficial Uses/Status

The primary purpose of this SBA is to determine if the listed streams conform to state of Idaho WQS. This is accomplished in four steps: 1) determine if a use is existing, 2) if the use is existing, determine compliance with WQS for use, 3) if the existing use is impaired, determine if impairment is associated with the pollutants listed on the 1998 §303(d) list; and 4) provide recommendations for future Idaho §303(d) lists.

Streams on the 1998 §303(d) list were placed there based on litigation, BURP monitoring, other agency data or best professional judgement. The state of Idaho presumes most waters in the state will support CWAL and PCR or SCR uses. In accordance with the WQS, the criteria to support the CWAL and PCR or SCR use is based on undesignated waters.

Questions remain on the beneficial uses and their status in the Upper Owyhee Watershed. For example, there is no data available that could be used to determine if any aquatic life exists in Juniper Basin Reservoir, nor could any data be found that would support placing the reservoir on the §303(d) list.

The SBA process attempts to answer questions concerning existing uses and use support. Due to the limitation of resources and time, usually only those pollutants listed on the §303(d) list are examined. Further evaluations were made to help fully understand what may be impairing a use, mainly CWAL (e.g., dissolved oxygen monitoring on Deep Creek, temperature monitoring on Nickel Creek). Further discussion of each §303(d) listed segment will follow. Table 7 describes the water bodies of concern and the determination of whether a use is existing and what the status of the use.

Table 7. Existing Use and Status for Listed Water Bodies. Upper Owyhee Watershed.

Streams	Cold Water Aquatic Life	Seasonal Cold Water Aquatic Life	Warm Water Aquatic Life	Modified Aquatic Life	Salmonid Spawning	Primary Contact Recreation	Secondary Contact Recreation
Blue Creek Reservoir	Existing/ Not Full Support	Not Evaluated	Not Evaluated	Not Evaluated	Not Existing	Existing/ Full Support	Existing/ Full Support
Juniper Basin Reservoir	Not Existing	Not Existing	Not Existing	Proposed	Not Existing	Existing/ Full Support	Existing/ Full Support
Deep Creek	Existing/ Not Full Support	Not Evaluated	Not Evaluated	Not Evaluated	Existing/ Not Full Support	Not Evaluated	Not Evaluated
Pole Creek	Existing/ Not Full Support	Not Evaluated	Not Evaluated	Not Evaluated	Existing/ Not Full Support	Not Evaluated	Not Evaluated
Castle Creek	Existing/ Not Full Support	Not Evaluated	Not Evaluated	Not Evaluated	Existing/ Not Full Support	Not Evaluated	Not Evaluated
Battle Creek	Existing/ Not Full Support	Not Evaluated	Not Evaluated	Not Evaluated	Existing/ Not Full Support	Existing/ Full Support	Existing/ Full Support
Shoofly Creek	Not Evaluated	Not Evaluated	Not Evaluated	Not Evaluated	Not Evaluated	Existing/ Full Support	Existing/ Full Support
Red Canyon Creek	Existing/ Not Full Support	Not Evaluated	Not Evaluated	Not Evaluated	Existing/ Not Full Support	Not Evaluated	Not Evaluated
Nickel Creek	Existing/ Not Full Support	Not Evaluated	Not Evaluated	Not Evaluated	Existing/ Not Full Support	Not Evaluated	Not Evaluated

Blue Creek Reservoir (WQLS #2627)

Blue Creek Reservoir does not have designated beneficial uses except for water supply, aesthetics and wildlife habitat (IDAPA§ 58.01.02140.04.). There is no indication that these uses are impaired. Existing uses include PCR or SCR, and CWAL. The CWAL and salmonid spawning existing uses are based on fish stocking conducted by IDFG in June 1999. Approximately 6,000 catchable domestic Kamloops trout were placed in the reservoir (IDFG 2001b). The listed pollutant of concern is sediment. It is not clear how Blue Creek Reservoir was placed on the 1998 §303(d) list. The IDFG has not provided any information on follow-up evaluation of fish survivability, reproduction or creel success.

Limited water quality monitoring was conducted in 2001 in Blue Creek Reservoir. Table 8 shows the results from monitoring in the reservoir conducted in 2001. More discussion of the data analysis is located in Section 2.4.

Table 8. Monitoring Results for Blue Creek Reservoir July 7, 2001. Upper Owyhee Watershed.

Site	Chlorophyll a (ug/l)	Diss. O-phosphate as P (mg/l)	Total Phosphorus (mg/l)	Total $NO_2 + NO_3$ as N (mg/l)	Total Suspended Solid (mg/l)	Turbidity (NTUs)
Reservoir at Surface (0.5 meters)	24.2	0.104	0.240	0.005	23	67
Reservoir at Bottom (3.2 meters)	NA	0.108	0.224	0.009	25	64

Juniper Basin Reservoir (WQLS #2627)

Juniper Basin Reservoir does not have designated beneficial uses except for water supply, aesthetics and wildlife habitat (IDAPA§ 58.01.02140.04.). There is no indication that these uses are impaired. Existing uses include PCR or SCR. The listed pollutant is sediment. It is not clear how Juniper Basin Reservoir was placed on the 1998 §303(d) list. Limited water quality monitoring was conducted in 2001 in Juniper Basin Reservoir.

Juniper Basin Reservoir is a shallow reservoir primarily constructed to deliver irrigation water. The irrigation system has been in disrepair for a long period of time and is totally inoperative. Livestock watering may be the only agricultural water use. It is unknown at this time if the main release valve from the reservoir is capable of releasing water from the reservoir. The reservoir is shallow and during a period in July 2001, the deepest part of the reservoir measured less than 2 meters (6.5 feet). Although not measured, in October of the same year the water depth was even less. Table 9 shows the monitoring results for Juniper Basin Reservoir conducted in July 2001.

Table 9. Monitoring Results for Juniper Basin Reservoir, July 6, 2001. Upper Owyhee Watershed.

Site	Chlorophyll a (ug/l)	Diss. O-phosphate as P (mg/l)	Total Phosphorus (mg/l)	Total $NO_2 + NO_3$ as N (mg/l)	Total Suspended Solid (mg/l)	Turbidity (NTUs)
Reservoir at Surface (0.5 meters)	25.5	NA	0.199	<0.005	11	72
Reservoir at Bottom (1.2 meters)	NA	NA	0.216	<0.005	14	72

The substrate is a deep layer of a fine sediment/clay type material. Substrate sampling with a dredge like device (Ponar) resulted in no material greater than silt size. More discussion of the data analysis is located in Section 2.4.

Inflow to Juniper Basin Reservoir during the summer months is non-existent. Juniper Creek and other streams upstream of the reservoir are ephemeral or intermittent streams.

Deep Creek (WQLS # 2614)

Deep Creek does not have designated beneficial uses except for water supply, aesthetics and wildlife habitat as specified in IDAPA§ 58.01.02140.04. There is no indication that these uses are impaired. Existing uses include CWAL, salmonid spawning and PRC or SCR. The existing uses of CWAL and salmonid spawning are based on the IDFG management plan to manage the watershed for wild redband trout (IDFG 2001b). The listed pollutants are temperature and sediment.

Idaho DEQ identified Deep Creek as beginning at the confluence of Nip and Tuck Creek and Hurry Back Creek (USGS 7.5 minute quadrangle map, Hurry Back). Deep Creek is approximately 46 miles long. When it reaches its confluence with the East Fork Owyhee River it is a 5th order stream. For much of its length, it is in a deep incised canyon with poor vehicle access. Aerial photos show the system has high flashy flows in the lower segment (canyon section) with large sediment deposits on the inside of meanders. The creek also has long wide glide areas feeding into short riffles. Deep Creek had continuous flow throughout the 2000 and 2001 monitoring seasons.

Three monitoring sites were established on Deep Creek (Ingham 2000). Temperature loggers were placed at these sites, and data were collected over an 18-month period. Biological, physical and chemical data were also collected at these sites.

Allen et al. (1993) found no redband trout at any sites in Deep Creek. However, a high density of redband trout was found in Nip and Tuck Creek approximately 2 miles upstream of the confluence with Hurry Back Creek (where the two join to form Deep Creek).

Idaho DEQ has two established BURP monitoring sites on Deep Creek. Table 10 shows the stream macroinvertebrate index (SMI) scores for the years monitoring was conducted.

The SMI scores indicate CWAL indicator species are present at the lower Deep Creek site at the road crossing. At the upper site near Mud Flat Road (also called Deep Creek Road), SMI scores indicate the site may or may not be supporting CWAL. Under the current edition of the *Water Body Assessment Guidance* (Idaho DEQ 2002), the SMI scores are rated as follows:

SMI	Support Status
>58	Condition Rating 3
49-57	Condition Rating 2
31-48	Condition Rating 1
<31	Minimum Threshold

Temperature data collected in 2000 and 2001 show temperatures exceeded the WQS for CWAL and salmonid spawning. More discussion of the data analysis is located in Section 2.4.

Table 10. Stream Macroinvertebrate Index Scores for Deep Creek. Upper Owyhee Watershed.

BURP ID # (year)	Description	Public Land Survey Description	SMI Score
1995SBOI012	Deep Creek near Mud Flat Rd.	10S 3W Sec 3	22.33
1995SBOIC006	Deep Creek near Mud Flat Rd.	10S 3W Sec 3	24.33
1996SBOI021	Deep Creek near Mud Flat Rd.	10S 3W Sec 3	65.82
1997SBOIA032	Deep Creek near Mud Flat Rd.	10S 3W Sec 3	50.73
1998SBOI023	Deep Creek near Mud Flat Rd.	10S 3W Sec 3	60.57
1995SBOI010	Deep Creek @ Lower Road Crossing	12S 3W Sec 11	45.55
1995SBOIC005	Deep Creek @ Lower Road Crossing	12S 3W Sec 11	41.78
1996SBOI018	Deep Creek @ Lower Road Crossing	12S 3W Sec 11	48.5
1997SBOIB031	Deep Creek @ Lower Road Crossing	12S 3W Sec 11	46.48
1998SBOIA022	Deep Creek @ Lower Road Crossing	12S 3W Sec14	51.46
1999SBOIA007	Deep Creek @ Lower Road Crossing	12S 3W Sec 11	62.17

Pole Creek (WQLS # 2617)

Pole Creek does not have designated beneficial uses except for water supply, aesthetics and wildlife habitat (IDAPA§ 58.01.02140.04.). There is no indication that these uses are impaired. Existing uses include CWAL, salmonid spawning and PCR or SCR. The existing uses of CWAL and salmonid spawning are based on BLM observations of redband trout in Pole Creek, mostly from the confluence with Deep Creek upstream to Indian Crossing (Zoellick, 2001). Allen et al. (1993) had no success in finding redband trout. The IDFG management plan includes management of the watershed for wild redband trout (IDFG 2001). The listed pollutants of concern are sediment, temperature and flow alteration.

Pole Creek was monitored in 2000 and 2001. The creek went dry about the end of August 2000 and in mid-July 2001. Biological assessments were conducted in June 2000. In accordance with the WQS, standards apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated. For recreation and water supply uses, optimum flow is equal to or greater than 5 cfs. For aquatic life uses, optimum flow is equal to or greater than 1 cfs (IDAPA§ 58.01.02.07.07).

The USGS 7.5 minute quadrangle map (Wagon Box Basin) shows that most of Pole Creek is a perennial stream, but does become intermittent below the Idaho DEQ temperature logger site. Below the confluence with Camas Creek the segment becomes perennial again. There are a few small storage impoundments in the watershed along with some spring developments for livestock watering. There is also some evidence of historic irrigation water withdrawals near Mud Flat Road, but it is not known if these systems are still used.

Water temperature data are available for an 18-month period at the Idaho DEQ site near the headwaters. Biological information was collected in June 2000 at the same site. The BLM collected some fish data in September 2000. The BLM also had temperature loggers placed at 2 sites on Pole Creek. Pole Creek is a very inaccessible stream and is generally characterized as a deep incised canyon. Access to most segments of Pole Creek is limited, so BLM data will be used in this assessment process.

In 1999, Idaho DEQ conducted BURP monitoring on Pole Creek (BURP Site ID #1999BOIA002). The SMI score was 50.55 (condition rating “2”), but no cold water indicators were present. In 2000 and 2001, water temperature data indicated there were some periods when the water temperature exceeded the WQS criteria for CWAL and salmonid spawning. A discussion of data is located in Section 2.4. The monitoring site is located at a site known as Indian Crossing (USGS 7.5 minute quad map, Castro Table). While PCR or SCR were not assessed, it is assumed they are fully supported since no data was presented to show bacteria are violating the WQS.

The EPA does not believe that flow, or lack of flow, is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution (e.g., flow alteration) but not a pollutant, a flow alteration TMDL will not be written for Pole Creek.

Castle Creek (WQLS #2616)

Castle Creek does not have designated beneficial uses except for water supply, aesthetics and wildlife habitat uses (IDAPA§ 58.01.02140. 04.). There is no indication that these uses are impaired. Existing uses include CWAL, salmonid spawning and PCR or SCR. The existing uses of CWAL and salmonid spawning are based on observations made in 1999 by the BLM

(Zoellick 2001). Zoellick states redband trout were observed approximately 1.5 to 2 miles upstream from the Deep Creek confluence. The IDFG management plan includes management of the watershed for wild redband trout (IDFG 2001). The listed pollutants for Castle Creek are sediment and temperature.

Idaho DEQ had two BURP sites on Castle Creek in 1996 (BURP Site ID #1996SBOIB019 and #1996SBOIB020). The SMI scores for these sites were 34.49 and 21.58, respectively. The site with the 21.58 SMI score is upstream of the Starr Ranch area, while the lower site is located further downstream near the Castro Ranch and about 1½ miles upstream from the confluence of Deep Creek. Both SMI scores indicate CWAL is not fully supported.

Castle Creek was monitored during 2000 and 2001. The creek went dry about the end of August 2000 and about the end of July 2001. In accordance with Idaho WQS, standards apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated. For recreation and water supply uses, optimum flow is equal to or greater than 5 cfs. For aquatic life uses, optimum flow is equal to or greater than 1 cfs (IDAPA§ 58.01.02.07.07).

The USGS 7.5-minute quadrangle map (Castro Table) shows that most of Castle Creek is a perennial stream. There are a few small storage impoundments in the watershed along with some spring development for livestock watering. There is also some evidence of historic irrigation water withdrawals near Starr Ranch, but it is not known if these systems are still used or if Castle Creek is a major source for irrigation water.

Biological assessment was conducted in June 2000 and again in June 2001. A continuous temperature logger was placed in Castle Creek near the confluence with Deep Creek. Temperature data indicate water temperatures exceed the WQS criteria for both CWAL and for salmonid spawning. More discussion of the data analysis is located in Section 2.4.

While PCR and SCR were not assessed during 2000 and 2001, it is assumed PCR and SCR are fully supported since no other information was provided to indicate these uses are impaired.

Battle Creek (WQLS #2621)

Battle Creek does not have designated beneficial uses except for water supply, aesthetics and wildlife habitat (IDAPA§ 58.01.02140.04.). There is no indication that these uses are impaired. Existing uses include CWAL, salmonid spawning and PCR or SCR. The IDFG management plan includes management of the watershed for wild redband trout (IDFG 2001). The segment is listed for bacteria from the headwaters to the confluence with the East Fork Owyhee River. Some diversions of Battle Creek and its smaller tributaries occur on private lands.

Bacteria samples collected at two sites on Battle Creek (Upper Crossing and Twin Bridges) showed PCR and SCR are fully supported. However, temperature data collected by the BLM in 2000 indicated exceedences of WQS. More discussion of the data analysis is located in Section 2.4.

Shoofly Creek (WQLS #2630)

Shoofly Creek does not have designated beneficial uses except for water supply, aesthetics and wildlife habitat (IDAPA§ 58.01.02140.04.). There is no indication that these uses are impaired. Beneficial uses evaluated were PCR and SCR because the listed pollutant for Shoofly Creek is bacteria. Samples collected in 2000 and 2001 showed the criteria for the support of PCR and SCR were not exceeded. More discussion of the data analysis is located in Section 2.4.

Red Canyon Creek (WQLS # 2613)

Red Canyon Creek is the only listed segment that has established designated uses (IDAPA§ 58.01.02140.04.SW-34). These uses are PCR, CWAL, water supply, aesthetics and wildlife habitat as specified in IDAPA§ 58.01.02140.04.

The existing uses of salmonid spawning and CWAL are based on research by Allen et al. (1993). They found redband trout throughout Red Canyon Creek in 1993. Densities ranged from 1.2 to 29.4 fish/100 square meters (100 m^2). The IDFG management plan includes management of the watershed for wild redband trout (IDFG 2001). IDFG has also determined that tributaries to the East Fork Owyhee River, in addition to Deep Creek and Battle Creek, should be managed for mixed species, which include redband trout. The listed pollutants of concern include sediment, temperature and flow alteration.

Red Canyon Creek was monitored in 2000 and 2001. The creek was determined to be intermittent because it was dry by the end of August 2000 and by mid-July 2001. Biological assessments were conducted in June 2000 and 2001. In accordance with the WQS, standards apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated. For recreation and water supply uses, optimum flow is equal to or greater than 5 cubic feet per second (cfs). For aquatic life uses, optimum flow is equal to or greater than 1 cfs (IDAPA§ 58.01.02.07.07).

The USGS 7.5 minute quadrangle map (Red Basin) shows Red Canyon Creek as a perennial stream. There are a few small storage impoundments in the watershed along with some spring diversions for livestock watering.

In 1999, Idaho DEQ conducted BURP monitoring on Red Canyon Creek. The SMI score was 63.36, a condition rating of “3”. (BURP Site ID #1999BOIA005). There was one cold water indicator species present in the sample. The monitoring site is approximately ¼ mile downstream of the confluence of the East and West Forks of Red Canyon Creek and approximately 5 miles upstream from the confluence with the East Fork of the Owyhee River.

Limited temperature data indicated there were periods when the water temperature exceeded the WQS criteria for CWAL and salmonid spawning. Water temperature data are available for June through August 2000. A discussion of this data is located in Section 2.4. While PCR was not assessed, it is assumed to be in full support, since there was no data presented indicating bacteria levels are violating WQS.

The EPA does not believe that flow, or lack of flow, is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution (e.g., flow alteration) but not a pollutant, a flow alteration TMDL will not be written for Red Canyon Creek.

Nickel Creek (WQLS# 6618)

Nickel Creek does not have designated beneficial uses except for water supply, aesthetics and wildlife habitat (IDAPA§ 58.01.02140.04.). There is no indication that these uses are impaired. Existing uses include CWAL, salmonid spawning and PCR or SCR. The existing uses of CWAL and salmonid spawning are based on a BLM notation in a 1982 grazing environmental impact statement that redband trout were common to rare from the confluence with Deep Creek to near Mud Flat Road (Zoellick, 2001). The IDFG management plan includes management of the watershed for wild redband trout (IDFG 2001). Neither IDFG nor the BLM provided any fish data for the listed segment (Mud Flat Road to the headwaters). The listed pollutant is sediment. However, it should be noted that Nickel Creek is spring fed and during the past two monitoring seasons, June through August 2000 and 2001, the segment above the springs was dry. The area below the springs, approximately ¾ mile upstream from Mud Flat Road, remained flowing. The stream is diverted near Mud Flat Road to irrigate pastures and hay lands.

Data from only one BURP site is available for Nickel Creek (BURP Site #1995SBOI011). The SMI score was 9.97. This score indicates CWAL is not fully supported. Also, continuous temperature data recording showed the temperature criteria for salmonid spawning, both maximum daily and average daily temperatures, were exceeded. More discussion of the data analysis is located in Section 2.4.

2.4 Summary and Analysis of Existing Water Quality Data

Temperature Data

All temperature data are based on available temperatures taken with recording thermographs from June 2000 through September 2001. Sites were equipped with HOBO® temperature loggers. Intervals were set for readings to be taken every one hour and twelve minutes, or for 20 readings during a twenty-four hour period. Ambient air temperatures were also taken at the same intervals at three sites (Ingham 2000). Loggers were removed from ambient air sites and Red Canyon Creek (dry in 2000) to prevent damage to the loggers during the winter.

Where data are not available for June 2001 through July 2001. Data from June and July of 2000 will be used as a substitute.

Applicable Temperature Standards

As stated in the WQS, during periods when the ambient air temperature exceeds the ninetieth percentile of the seven day average daily maximum air temperature, the criteria for the support of aquatic life uses and salmonid spawning will not be applied. IDAPA§ 58.01.02.080.04 reads, “Exceeding the temperature criteria in Section 250 will not be considered a water quality standard violation when the air temperature exceeds the ninetieth percentile of the seven (7) day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station." The ambient air temperature recorded at the weather reporting station at Hollister, Idaho (Strong 2000), were used as the air temperatures for the region. Information for this weather reporting station is located at the Climatic Service Center Internet site.

For the two periods of May through September 2000 and May through September 2001, only three dates exceeded the ninetieth percentile of the seven day average daily maximum air temperature. The ninetieth percentile of the seven day average daily maximum air temperature pertaining to the Upper Owyhee Watershed is 34.3 ^{o}C (Strong 2000). Since there were so few exceedences (less than 1%), they will not be calculated into the overall data results.

Applicable Temperature Criteria

Cold Water Aquatic Life

The temperature criteria for determining compliance with WQS for the support of CWAL are located in IDAPA§ 58.01.02.250.02.b. There are two different criteria used to determine compliance with WQS. The daily maximum temperature must be no more than 22 ^{o}C, and the maximum daily average temperature must be no more than 19 ^{o}C.

Seasonal Cold Water Aquatic Life

The temperature criteria for determining compliance with WQS for the support of seasonal CWAL are located in IDAPA§ 58.01.02.250.03.b. There are two different criteria used to determine compliance with WQS. The daily maximum temperature must be no more than 26 ^{o}C, and the maximum daily average temperature must be no more than 23 ^{o}C.

Salmonid Spawning

The temperature criteria for determining compliance with WQS for the support of salmonid spawning are located in IDAPA§ 58.01.02.250.02.e.ii. There are two different criteria used to determine compliance with WQS. The daily maximum temperature must be no more than 13 ^{o}C, and the maximum daily average temperature must be no more than 9 ^{o}C. The application of WQS criteria for salmonid spawning apply to those periods during spawning and the incubation period for the particular species inhabiting those waters. The IDFG suggests that the applicable period for redband trout spawning and incubation is from about mid-March until mid-July (IDFG 2001a).

Temperature Impairment

As water temperature increases a fish's metabolic rate also increases, which then requires more oxygen intake by fish. Warmer water temperature may also cause an increase in the presence of disease-causing organisms. Fish may be more subject to these diseases during periods of stress brought on by warmer water temperature. However, the greatest temperature-caused problem for certain cold water species is the amount of dissolved oxygen (DO) within the water column. As water temperature increases the oxygen solubility decreases. This creates less available oxygen in the water.

For CWAL, the criteria for DO can be found in IDAPA§ 58.01.02.250,02.a. For salmonid spawning, the criteria can be found in IDAPA§ 58.01.02.250,02.e.i. (1)(a) and (b), and IDAPA§ §58.01.02.250,02.e.i. (2)(a).

The presence of nuisance aquatic growth brought on by an abundance of available nutrients and sunlight may also compound the situation by causing DO sags. Streams that lack adequate shading have been shown to have large mats of filamentous algae growth in the Upper Owyhee Watershed.

Data Analysis

Deep Creek

Deep Creek is by far the largest subwatershed within the Upper Owyhee Watershed. Deep Creek takes in four 5th field HUCs and encompasses an area of 274,000 acres. The main 5th field HUCs are Deep Creek, Dickshooter Creek, and Hurry Back Creek. Pole Creek makes up the other 5th field. In 2000, three temperature monitoring sites were established (Ingham 2000). Each site's data results will be discussed for 2000 and 2001.

Deep Creek (Upper)

This site is located approximately 300 meters below Mud Flat Road and approximately 400 meters below the confluence of Hurry Back Creek and Nip and Tuck Creek. These two streams form Deep Creek.

Data used in this analysis are from June 23 through August 31, 2000, and from June 1 through August 31, 2001. For the period from June 23 through August 31, 2000 maximum daily temperature criterion for the support of CWAL was exceeded on 90% of all dates. The maximum daily average temperature criterion was exceeded 86% of all dates. For salmonid spawning, the maximum daily temperature and the maximum daily average temperature criteria both were exceeded daily. Table 11 shows the statistical breakdown of results for Deep Creek at Mud Flat Road.

Table 11. Statistical Analyses of Temperature Data for Deep Creek at Mud Flat Road. Upper Owyhee Watershed.

Year and Critical Period	95th Percentile °C	Maximum °C	Minimum °C	Average °C
2000 June 23 thru August 31 Maximum Daily CWAL	26.9	27.5	16.0	24.4
2000 June 1 thru August 31 Maximum Daily Average CWAL	19.6	20.7	14.0	17.8
2000 June 23 thru July 15 Maximum Daily SS	26.3	26.3	21.7	24.2
2000 June 23 thru July 15 Maximum Daily Average SS	18.4	18.6	15.3	17.2
2001 June 1 thru August 12 Maximum Daily CWAL	25.4	26.3	13.3	21.7
2001 June 1st thru August 12 Maximum Daily Average CWAL[a]	19.2	20.4	11.1	16.6
2001 June 1 thru July 15 Maximum Daily SS[b]	25.6	26.3	13.3	21.8
2001 June 1 thru July 15 Maximum Daily Average SS	19.4	20.4	11.1	16.1

[a] Cold Water Aquatic Life, [b] Salmonid Spawning

The maximum temperature recorded during the critical period will be used to develop the TMDL (Idaho DEQ 2001). For Deep Creek near Mud Flat Road the CWAL maximum daily temperature reduction goal will be based on 27.5 °C. For the maximum daily average temperature, the reduction goal will be based on 20.7 °C. For salmonid spawning, the maximum daily temperature reduction will be based on 26.3° C and for the maximum daily average temperature, the reduction goal will be based on 20.4 °C.

Deep Creek (Middle)

This station is located 2 miles below the confluence with Pole Creek and approximately 12 miles upstream from the East Fork Owyhee River. Inaccessible canyons dominate the area upstream from this site. Temperature loggers were placed about 100 meters below the confluence with Castle Creek.

Data used in this analysis are from periods from June 23 to August 31, 2000, and from June 1 through August 31, 2001. For the period from June 23 through August 31, 2000, the maximum daily temperature criterion for the support of CWAL was exceeded on 98% of all dates. The maximum daily average temperature criterion was exceeded on 91% of all dates. For salmonid spawning, the maximum daily temperature and the maximum daily average temperature criteria both were exceeded daily. Table 12 shows the statistical breakdown of results obtained in 2000 and 2001 for Deep Creek at Castle Creek.

Table 12. Statistical Analysis of Temperature Data for Deep Creek at Castle Creek. Upper Owyhee Watershed.

Year and Critical Period	95th Percentile in °C	Maximum in °C	Minimum in °C	Average in °C
2000 June 1 thru August 31 Maximum Daily CWAL[a]	28.3	29.1	19.0	25.9
2000 June 1 thru August 31 Maximum Daily Average CWAL	23.4	24.6	16.9	21.4
2000 June 1 thru July 15 Maximum Daily SS[b]	27.9	27.9	21.7	25.8
2000 June 1 thru July 15 Maximum Daily Average SS	22.7	22.7	18.4	21.1
2001 June 1 thru August 31 Maximum Daily CWAL	27.7	28.3	16.0	24.1
2001 June 1 thru August 31 Maximum Daily Average CWAL	23.1	23.7	13.6	20.1
2001 June 1 thru June 18 Maximum Daily SS	24.0	24.0	16.0	21.1
2001 June 1 thru June 18 Maximum Average Daily SS	20.2	20.4	13.6	17.5

[a] Cold Water Aquatic Life, [b] Salmonid Spawning

The maximum temperature recorded during the critical period will be used to develop the TMDL (Idaho DEQ 2001). For Deep Creek at Castle Creek, the CWAL maximum daily temperature reduction goal will be based on 29.1 °C. For the maximum daily average temperature, the reduction goal will be based on 24.6 °C. For salmonid spawning, the maximum daily temperature reduction goal will be based on 27.9 °C, and the "maximum daily average" temperature reduction goal will be based on 22.7 °C.

Deep Creek Lower

The lower Deep Creek site is a substitute for the original site which was to be located another 5 miles downstream (Ingham 2000). The substitute site was chosen after it was determined the original site would be too resource intensive to sample and too risky to make multiple visits. Deep Creek Lower is approximately 4 miles below the Castle Creek site. The landform upstream from this site is open; downstream the stream enters into an incised canyon. This site is at the only road crossing between the East Fork Owyhee River and the Mud Flat Road.

Data used in this analysis are from periods from June to August 31, 2000, and from June 1 through August 31, 2001. For the period from June 23 through August 31, 2000, the maximum daily temperature criterion for the support of CWAL was exceeded on 85% of all dates. The maximum daily average temperature criterion was exceeded 74% of all dates. For salmonid spawning, the maximum daily and the maximum daily average temperature criteria were both exceeded daily. Table 13 shows the statistical breakdown of results obtained in 2000 and 2001 for Lower Deep Creek at Road Crossing.

Table 13. Statistical Analyses of Temperature Data for Deep Creek at Road Crossing. Upper Owyhee Watershed.

Year and Critical Period	95th Percentile °C	Maximum °C	Minimum °C	Average °C
2000 June 22 thru August 31 Maximum Daily CWAL[a]	30.3	31.1	18.7	26.9
2000 June 22 thru August 31 Maximum Daily Average CWAL	23.1	23.9	16.0	21.2
2000 June 22 thru July 15 Maximum Daily SS[b]	29.8	30.7	23.2	27.3
2000 June 22 thru July 15 Maximum Daily Average SS	23.0	23.1	18.7	21.4
2001 June 1 thru August 31 Maximum Daily CWAL	29.6	31.5	16.0	26.1
2001 June 1 thru August 31 Maximum Daily Average CWAL	22.8	23.6	14.0	19.9
2001 June 1 thru June 18 Maximum Daily SS	25.6	25.6	16.0	22.1
2001 June 1 thru June 18 Maximum Average Daily SS	20.3	20.7	14.0	17.4

[a] Cold Water Aquatic Life, [b] Salmonid Spawning

The maximum temperature recorded during the critical period will be used (Idaho DEQ 2001). For Deep Creek Lower at Road Crossing the CWAL maximum daily temperature reduction goals will be based on 31.5 °C. For the maximum daily average temperature, the reduction goal will be based on 23.9 °C. For salmonid spawning, the maximum daily temperature reduction goal will be based on 30.7 °C, and the maximum daily average temperature reduction will be based on 23.1 °C.

Pole Creek (near Mud Flat Road)

Since Pole Creek went dry in 2000 and 2001, temperature data are limited to a short period from June through August 2000 and from March through August 2001. Some data for August 2000 and August 2001 have been removed from calculation since the stream appeared to drop below the criteria for intermittent streams. For the period from June 23 through August 31, 2000 at Pole Creek near Mud Flat Road the maximum daily temperature criterion for the support of CWAL was exceeded on 90% of all dates. The maximum daily average temperature criterion was exceeded 85% of all dates. For salmonid spawning, the maximum daily temperature and the maximum daily average temperature criteria were exceeded daily for the period from June 23 through July 15.

In 2001, for the period from June 1 through August 12, the maximum daily temperature criterion for the support of CWAL was exceeded on 44% of all dates. The maximum daily average temperature criterion was exceeded 86% of all dates. For salmonid spawning, for the period from June 1 through July 15, the maximum daily temperature and the maximum daily average temperature criteria were exceeded daily. Table 14 shows the statistical analysis for Pole Creek near Mud Flat Road.

Table 14. Statistical Analyses of Temperature Data for Pole Creek near Mud Flat Road. Upper Owyhee Watershed.

Year and Critical Period	95th Percentile °C	Maximum °C	Minimum °C	Average °C
2000 June 23 thru August 31 Maximum Daily CWAL [a]	25.5	26.3	16.8	22.7
2000 June 1 thru August 31 Maximum Daily Average CWAL	22.6	23.7	13.7	20.4
2000 June 23 thru July 15 Maximum Daily SS[b]	22.8	22.9	18.7	21.1
2000 June 23 thru July 15 Maximum Daily Average SS	20.8	21.0	17.0	19.5
2001 June 1 thru August 12 Maximum Daily CWAL	24.9	25.0	17.7	21.1
2001 June 1 thru August 12 Maximum Daily Average CWAL	21.9	22.6	12.9	18.8
2001 June 1 thru July 15 Maximum Daily SS	23.7	22.0	14.5	20.5
2001 June 1 thru July 15 Maximum Daily Average SS	22.0	22.6	12.9	18.2

[a] Cold Water Aquatic Life, [b] Salmonid Spawning

The maximum temperature recorded during the critical period will be used to develop the TMDL (Idaho DEQ 2001). For Pole Creek, the CWAL maximum daily temperature reduction goal will be based on 26.3 °C. For the maximum daily average, reduction goals will be based on 23.7 °C. For salmonid spawning, the maximum daily temperature reduction goal will be based on 22.9 °C. For salmonid spawning the maximum daily average reduction goal will be based on 21 °C.

Pole Creek (near Camel Creek)

This Pole Creek site is a site where BLM collected temperature data during the summer of 2000. Data used in these analyses are for a period from July 12 through August 31, 2000. For the period from July 12 through August 31 at Pole Creek near Camel Creek the maximum daily temperature criterion for the support of CWAL was exceeded on 90% of all dates. The maximum daily average temperature criterion was exceeded on 86% of all dates. For salmonid spawning, the maximum daily temperature and the maximum daily average temperature criteria were not evaluated because the data were taken outside the spawning time frame. Table 15 shows the statistical breakdown of results obtained in 2000 for Pole Creek near Camel Creek.

Table 15. Statistical Analyses of Temperature Data for Pole Creek near Camel Creek. Upper Owyhee Watershed.

Year and Critical Period	95th Percentile °C	Maximum °C	Minimum °C	Average °C
2000 July 12 thru August 31 Maximum Daily CWAL[a]	25.6	30.1	19.1	23.8
2000 July 12 thru August 31 Maximum Daily Average CWAL	23.5	24.9	16.8	21.1

[a] Cold Water Aquatic Life

The maximum temperature recorded during the critical period will be used to develop the TMDL (Idaho DEQ 2001). For Pole Creek near Camel Creek, the CWAL maximum daily temperature reduction goals will be based on 30.1 ^{o}C. For the maximum daily average temperature the reduction goal will be based on 24.9 ^{o}C. For salmonid spawning, temperature reductions will not be established at this site due to a lack of data.

Pole Creek (upstream of Camel Creek)

This Pole Creek site is a site where BLM collected temperature data during the summer of 2000. Data used in this analysis are for a period from July 13 to August 31, 2000. For the period from July13 through August 31 at Pole Creek near Camel Creek the maximum daily temperature criterion for the support of CWAL was exceeded on 16% of all dates. The maximum daily average temperature criterion was exceeded 84% of all dates. For salmonid spawning, the maximum daily temperature and the maximum daily average temperature criteria were not evaluated because the data were taken outside the spawning time frame. Table 16 shows the statistical breakdown of results obtained in 2000.

Table 16. Statistical Analyses of Temperature Data for Pole Creek upstream of Camel Creek. Upper Owyhee Watershed.

Year and Critical Period	95th Percentile ^{o}C	Maximum ^{o}C	Minimum ^{o}C	Average ^{o}C
2000 July 13 thru August 31 Maximum Daily CWAL[a]	22.7	23.2	19.4	21.2
2000 July 13 thru August 31 Maximum Daily Average CWAL	21.7	22.6	17.3	20.1

[a] Cold Water Aquatic Life

The maximum temperature recorded during the critical period will be used to develop the TMDL (Idaho DEQ 2001). For Pole Creek upstream of Camel Creek, the CWAL maximum daily temperature reduction goals will be based on 23.2 ^{o}C. For the maximum daily average temperature the reduction goal will be based on 22.5 ^{o}C. For salmonid spawning, temperature reductions will not be established at this site due to a lack of data.

Castle Creek

Since Castle Creek went dry in 2000 and 2001, temperature data are limited to a short period from June 2000 through August 2000. For the period from June 23 through August 24, 2000 the maximum daily temperature criterion for the support of CWAL was exceeded daily. The maximum daily average temperature criterion was exceeded 81% of the time. For salmonid spawning, the maximum daily temperature and the maximum daily average temperature criteria were exceeded daily from June 23 through July 15. Table 17 shows the statistical breakdown of results obtained in 2000.

Table 17. Statistical Analysis of Temperature Data for Castle Creek. Upper Owyhee Watershed.

Year and Critical Period	95th Percentile °C	Maximum °C	Minimum °C	Average °C
2000 June 23 thru August 31 Maximum Daily CWAL[a]	30.3	31.1	17.1	26.6
2000 June 23 thru August 31 Maximum Daily Average CWAL	21.1	21.4	13.3	19.4
2000 June 23 thru July 15 Maximum Daily SS[b]	30.3	31.1	22.1	27.4
2000 June 23 thru July 15 Maximum Daily Average SS	21.1	21.3	17.1	19.5

[a] Cold Water Aquatic Life, [b] Salmonid Spawning

The maximum temperature recorded during the critical period will be used to develop the TMDL (Idaho DEQ 2001). For Castle Creek, the CWAL maximum daily temperature reduction goal will be based on 30.3 °C. For the maximum daily average, reduction goals will be based on 21.1 °C. For salmonid spawning, the maximum daily temperature reduction goal will also be based on 27.4 °C. For salmonid spawning the maximum daily average reduction goal will be based on 19.5 °C.

Red Canyon Creek

Since Red Canyon Creek went dry in 2000 and 2001, temperature data are limited to a short period from June 2000 through August 2000. For the period from June 23 through August 31 the maximum daily temperature criterion for the support of CWAL was exceeded 47% of the days. The maximum daily average temperature criterion was not exceeded. For salmonid spawning, the maximum daily and the maximum daily average temperature criteria were exceeded daily for the period from June 23 through July 15. Table 18 shows the statistical breakdown of results obtained in 2000.

Table 18. Statistical Analyses of Temperature Data for Red Canyon Creek. Upper Owyhee Watershed.

Year and Critical Period	95th Percentile °C	Maximum °C	Minimum °C	Average °C
2000 June 23 thru August 31 Maximum Daily CWAL[a]	23.9	25.2	15.6	20.6
2000 June 23 thru August 31 Maximum Daily Average CWAL	17.7	18.6	14.2	15.9
2000 June 23 thru July 15 Maximum Daily SS[b]	24.3	25.2	15.6	21.0
2000 June 23 thru July 15 Maximum Daily Average SS	16.5	16.9	14.2	15.5

[a] Cold Water Aquatic Life, [b] Salmonid Spawning

The maximum temperature recorded during the critical period will be used (Idaho DEQ 2001). For Red Canyon Creek, the CWAL maximum daily temperature reduction goal will be based on 25.2 ^{o}C. For salmonid spawning, the maximum daily temperature reduction goal will also be based on 25.2 ^{o}C. For salmonid spawning the maximum daily average reduction goal will be based on 16.9 ^{o}C.

Sediment Data

Applicable Sediment Standards

The state of Idaho utilizes narrative sediment criteria and numeric turbidity criteria to determine if there are violations of WQS. Under IDAPA§ 58.01.02.200.08, "Sediment shall not exceed quantities specified in Sections 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Section 350."

It should be noted that with an absence of a numeric criterion for sediment, some TMDLs in Idaho have set targets for total suspended solids (TSS), suspended sediment and/or substrate embeddeness or percent fines. Once impairment to the beneficial uses has been determined, as described in IDAPA§ 58.01.02.200.08, an interpretation or an extrapolation is made with the use of literature values. These values can either define a water column allocation, substrate targets and/or both.

Section 250 of the WQS describes applicable turbidity levels. IDAPA§ 58.01.02.250.02.d. states "Turbidity, below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than fifty (50) Nephelometric Turbidity Units (NTUs) instantaneously or more than twenty-five (25) NTU for more than ten (10) consecutive days."

The state WQS addresses background in IDAPA §58.01.02.003.006, which states, "The biological, chemical or physical condition of waters measured at a point immediately upstream (up-gradient) of the influence of an individual point or nonpoint source discharge. If several discharges to the water exist or if an adequate upstream point of measurement is absent, the department will determine where background conditions should be measured." With this definition in mind, the determination of background turbidity level can only be made from an area that has no anthropogenic sources that would affect water quality.

Section 252 of the WQS is the applicable standard for domestic water supply, industrial water supply and agricultural water supply. However, no numeric criteria are included to protect these uses with these uses protected under the general water quality standards (IDAPA §58.01.02.200).

Section 350 of the WQS addresses procedures to be taken if a nonpoint source is determined to be impairing beneficial uses. Section 350 also describes the State of Idaho implementation policy for addressing nonpoint sources and applicable best management practices (BMPs).

Sediment Impairments

Both suspended sediment and bedload sediment can impair beneficial uses. Suspended sediment can impair sight feeding fish by reducing their capability to find food. It may also aggravate gills and reduce oxygen intake. Bedload sediment can disturb habitat for macroinvertebrates, fill in interstitial spaces required for spawning and rearing areas, and fill in pools needed for refuge.

There are a variety of studies to determine the effects of sediment and turbidity on salmonid species. Sigler, Bjorn and Forest (1984) determined turbidity levels as low as 25 NTUs can cause a reduction in fish growth, and levels between 100-300 NTUs will cause fish to die or seek refugee in other channels. Lloyd (1987) suggested for moderate level protection of salmonid species turbidity levels up to 23 NTUs. For a high level of protection, Lloyd (1987) suggested turbidity levels up to 7 NTUs. The state of Nevada has set a numeric turbidity standard of less than or equal to 25 NTUs for the protection of aquatic life, water supply and recreational use in Lake Mead on the Nevada-Arizona border (State of Nevada NAC §445A.195).

Most studies have demonstrated that turbidity levels exceeding 25-30 NTUs will impair aquatic life use by causing reduced fish growth, reduced survival, reduced abundance, respiratory stress, and increased ventilation (Bash, Berman and Bolton 2001). Avoidance, reduced energy intake and displacement can occur at turbidity levels of 22 to greater than 200 NTUs.

Suspended sediment concentrations at levels of 100 milligrams per liter (mg/l) have shown reduced survival of juvenile rainbow trout (Herbert and Merkens 1961). The covering of spawning gravels have shown to decrease the survivability during incubation and emergence (Bash, Berman and Bolton 2001). Chronic turbidity during emergence and rearing of young anadromous salmonid could affect the quantity and quality of fish produced (Sigler et al., 1884). Sediment may also alter the hyporheic conditions, reducing ground water flows and increasing water temperature (Poole and Berman 2001).

Surface fines can impair benthic species and fisheries by limiting the interstitial space for protection and suitable substrate for nest or redd construction. Certain primary food sources for fish (Ephemeroptera, Plecoptera and Tricoptera species [EPT]) respond positively to a gravel to cobble substrate (Waters 1995). Substrate surface fine targets are difficult to establish. However, as described by Relyea, Minshall and Danehy (2000), macroinvertebrates (Plecoptera) intolerant to sediment are mostly found where substrate cover is less than 30% (<6mm). More sediment tolerant macroinvertebrates (Plecoptera) are found where the substrate cover is greater than 30% (<6mm).

Most studies have focused on smaller streams, A, B and C channel types (Rosgen 1996). Studies conducted on Rock Creek (Twin Falls County, Idaho) and Bear Valley Creek (Valley County, Idaho) found percent fines above 30% begin to impair embryo survival (Idaho DEQ 1990). Overton et al. (1995) found natural accumulation of percent fines were about 34% in C channel types. Most C channel types exhibit similar gradient as F channel types, <2.0% (Rosgen 1996).

The small mouth bass species (*Micropeterus dolomieui*), found throughout the Upper Owyhee River Watershed, require adequate substrate for nest building. This substrate could be sand or gravel (Simpson and Wallace 1982). The sucker species found in the area (*Catostomus macrohelus*) prefers gravel to rocky substrate. Northern Pikeminnow (*Ptychocheilus oregonensis*) uses streams and rivers for spawning activity, but is more of a broadcast spawner than nest builder (Simpson and Wallace 1982). Sculpin (*Cottus baird*) are also known to inhabit waters in the Upper Owyhee Watershed. Sculpin prefer clean water and clean gravel for habitat.

Salmonid species require clean, well-oxygenated gravels for spawning, incubation and emergence. Intergravel space is required for fry development, primary food source and refuge. Pools are required for mature fish development and provide areas of refugia during high water temperature, and prey protection (Burton 1991)

To determine if sediment is impairing existing beneficial uses, macroinvertebrates and periphyton samples were collected on those systems listed as being impaired by sediment. Two sets of samples were collected in 2000 and two sets in 2001.

Data Analysis

Blue Creek Reservoir

Very little information is available for Blue Creek Reservoir. However, turbidity levels did exceed accepted levels for the support of CWAL, and a TMDL will be developed to address sediment in the reservoir. Periphyton data included the presence of motile species, which indicates severe impairment from sediment. The siltation index used by the state of Montana showed poor water quality due to sediment.

Juniper Basin Reservoir

Periphyton results for Juniper Basin Reservoir indicated that sediment is a severe impairment to water quality in the reservoir. Turbidity levels did exceed accepted levels for the support of CWAL, and a TMDL will be developed to address sediment in the reservoir. However, it is not believed that an aquatic life use may be viable for the reservoir (Ingham 2001). See the discussion of existing use and beneficial use status in Section 2.3.

Deep Creek (Upper)

Allen et al. (1993) found no redband trout at any sites in Deep Creek that they evaluated. However, a high density of redband trout were found in Nip and Tuck Creek approximately 2 miles upstream of the confluence with Hurry Back Creek (Deep Creek). Idaho DEQ has not collected any fishery data through the BURP process for Deep Creek. Macroinvertebrates collected at a site near Mud Flat Road showed the expected cold water indicators were not present or the data needed verification. Periphyton analyses from samples collected in 2000 and in 2001 indicated sediment is impairing the expected algae-diatom species. The siltation index used in the state of Montana indicated that sediment is severely impairing the expected communities and the presence of motile diatom species reconfirms the impairment of coldwater indicators (Bahls 2000b and 2001a). Table 19 shows the metric analysis for samples collected in 2000 and 2001 for Upper Deep Creek.

Macroinvertebrate analysis of samples collected in 2000 showed that sediment was also impairing the expected macroinvertebrate community structure at the Upper Deep Creek site.

The presence of a Plecoptera species that is moderately tolerant to sediment, but the lack of other Plecoptera intolerant species indicated sediment is impairing the site. Table 20 shows the breakdown of results for the macroinvertebrate analysis.

Deep Creek (Middle)

Allen et al. (1993) found no redband trout at any sites in Deep Creek that they evaluated in 1993. However, a high density of redband trout were found in Nip and Tuck Creek approximately 2 miles upstream of the confluence with Hurry Back Creek (Deep Creek). Idaho DEQ has not collected any fishery data through the BURP process. There are no macroinvertebrate SMI scores available for this site since it is not an established BURP site.

Periphyton analysis from this site only indicated slight to minor impairment. The impairment is from organic loading and not associated with sediment. Reports developed by Bahls (2001*a* and 2001*b*) indicated there is some nutrient and organic enrichment at this site. Periphyton metric analyses are located in Table 19. Macroinvertebrate analyses indicate most of the EPT species found were those species that are moderately tolerant to sediment (Clark 2002). Macroinvertebrate analyses are located in Table 20.

Although there does not appear to be evidence that sediment is impairing the uses in Deep Creek near Castle Creek, there appears to be enough evidence that the system is borderline impaired from sediment. Also, with the lack of any fisheries information, including the presence or absence of salmonids and salmonid spawning, it can be extrapolated that sediment is a factor in the lack of support of CWAL in this portion of Deep Creek.

Deep Creek (Lower)

Periphyton analyses from this site only indicated slight to minor impairment. The impairment is from organic loading and not associated with sediment based on reports developed by Bahls (2001*a* and 2001*b*), which indicate there is some nutrient and organic enrichment at this site that is causing minor impairment. The periphyton metric analysis is located in Table 19.

Macroinvertebrate analyses indicated most of the EPT species found were those species that are moderately tolerant to sediment (Clark 2002). However, no Plecoptera species were found, which indicates fine sediment is impairing the uses at this site. Macroinvertebrate analysis is located in Table 20. Further available fisheries data also indicate that sediment is impairing cold water species at this site. Salmonids rely on the cold water macroinvertebrates as a main source of food.

Pole Creek

The 1995 BURP data showed an MBI of 3.22. This score indicated more evaluation of Pole Creek was required or the data needed verification. Therefore, Idaho DEQ conducted more BURP monitoring in 1999. At that time, the SMI score was 50.55 (BURP Site ID #1999BOIA002), a condition rating of 2. Percent fines showed the less than 6 mm size material covered 15% of the substrate.

The 1995 BURP data showed the less than 6 mm size material covered 21% of the substrate (BURP Site ID #1995BOIB013). Allen et al. (1993) evaluated substrate during their fish collecting effort in Owyhee County. At one site near the confluence with Deep Creek, they calculated 19% of the substrate was less than 6 mm. At another site near the confluence with Camas Creek, they calculated 55% of the substrate was less than 6 mm.

Allen et al. (1993) found no salmonid species during electrofishing. The BLM observed some redband trout at three different locations on Pole Creek in 1999, but these were thought to be fish greater than 200 mm in length. Fish sizes ranged from 200 mm to 400 mm, which would indicate the presence of two age classes. Fish under 100 mm are very difficult to observe. The 1995 BURP electrofishing effort near Indian Crossing (BURP Site #1995SBOIB014) produced no salmonid species.

Periphyton analyses of samples collected in Pole Creek in 2001 at the Indian Creek Crossing site only indicated slight impairment of beneficial uses, but the siltation index indicates that sediment is not a source of impairment to those species of soft body algae and diatom present.

Macroinvertebrates were collected in 2001 in Pole Creek. However, at the time of the development of this SBA the results from that collection effort have not been received. If the results from the 2001 collection effort indicate any conclusions other than those found previously, the SBA will be amended to show any changes in the assessment.

Biological data do not indicate sediment as a source of impairment to the existing use of CWAL. Therefore, a TMDL for sediment will not be developed. As part of the TMDL and BURP processes, water bodies will be revisited every five years and reevaluated through the reconnaissance process. If it is determined at that time that sediment levels have been increased to levels that are impairing the existing uses, then modifications to the Upper Owyhee Watershed SBA-TMDL will occur.

Castle Creek

The two sets of BURP data on Castle Creek indicated that cold water indicator species are not present in Castle Creek. With limited fisheries information, no age class determination can made in Castle Creek

Periphyton samples were collected on Castle Creek in 2000 and in 2001. The 2000 sample set includes samples for June and September. The 2001 sample set only has results for July. The results from the 2000 sampling siltation index indicate that sediment was impairing the expected algae-diatom communities in Castle Creek. The siltation index used by the state of Montana showed the presence of a large number of motile species. The presence of motile species indicates sediment and silt are impairing the expected algae-diatom diversity. The reports generated by Bahls (2001*a* and 2001*b*) also indicated slight to moderate impairment from organic loading. Table 19 shows the results from the 2000 and 2001 periphyton analysis.

Macroinvertebrate results and bioasssessment scores for Castle Creek in 2000 indicated that fine sediment is impairing the uses in the stream (Clark 2002). Both the overall taxa richness and the analysis of the orders of EPT indicated sediment is impairing the expected cold water indicators. Table 20 shows the bioassessment results for all streams.

Macroinvertebrates were collected in 2001 in Castle Creek. However, at the time of the development of this SBA the results from that collection effort have not been received. If the results from the 2001 collection effort indicate any conclusions other than those found previously, the SBA will be amended to show any changes in the assessment.

Red Canyon Creek

As mentioned in the existing beneficial use status section, Red Canyon Creek's SMI score was 63.36. There was one cold water indicator species present (BURP Site ID #1999BOIA005). Allen et al. (1993) found redband trout throughout Red Canyon Creek. Densities ranged from 1.2 to 29.4 fish/100 m^2.

Fish data collected in 1993 show a diverse age class population in the lower segment near the confluence with the East Fork Owyhee River (Allen et al. 1993). Three different lengths were recorded: less than 100 millimeters (mm), greater than 100 mm but less than 200 mm, and greater than 200 mm. With numerous young of the year (YOY) found in Red Canyon Creek a determination can made that sufficient habit is present for a self-propagating population.

Further analysis of percent fines indicates sediment is not the limiting factor for the not full support status for Red Canyon Creek. Allen et al. (1993) showed that at sites where fish surveys were conducted on average 18% of the substrate was less than 6 mm. Idaho BURP data from 1999 showed that fines of less than 6 mm were less than 5% of the substrate. Both sets of data indicate substrate fines are less than levels that would or could impair CWAL or salmonid spawning (Overton et al. 1995). With the presence of YOY salmonid species, it can be determined sediment is not a pollutant of concern.

The percent fines presented (collected at the road crossing near the confluence of the East and West Forks of Red Canyon Creek) may show some bias due to the site gradient. This site has a higher gradient than what would be found in the lower canyon segment; thus, it is probable the percent fines could be higher in the lower segment where stream gradient is lower.

Analyses of periphyton samples collected in Red Canyon Creek in 2001 indicated a slight impairment of uses, but the siltation index indicates that sediment is not the source of use impairment and expected periphyton communities are present (Bahls 2001a and 2001b). Table 19 shows the results of the 2000-2001 collection effort for all streams.

Reports developed by Bahls (2001a and 2001b) using metrics developed for the state of Montana indicate slight impairment from some nutrient enrichment. The report also noted excellent biodiversity in the periphyton community.

Macroinvertebrates were collected in 2001 from Red Canyon Creek. However, at the time of the development of this SBA the results from that collection effort have not been received. If the results from the 2001 effort indicate any conclusions other than those found previously, the SBA will be amended to show any changes in the assessment.

Biological data do not indicate sediment is a source of impairment to the existing use of CWAL. Therefore, a TMDL for sediment will not be developed. As part of the TMDL and BURP process, water bodies will be revisited every five years and reevaluated through the reconnaissance process. If it is determined at that time that sediment have increased to levels that are impairing the existing uses, then modifications to the Upper Owyhee Watershed SBA-TMDL will occur.

Nickel Creek

The only BURP data available for the Nickel Creek segment on the §303(d) list, shows expected cold water indicators are not present and there are major impairments to CWAL. There are no fisheries data for this segment and no reported fish observations below this segment. Since the temperature standard for the support of CWAL is not exceeded, it is expected there are other sources of impairment.

Periphyton analyses showed there is minor impairment, with a pollution index score also showing minor impairment. However, the siltation index indicates sediment is not a source of the impairment. Reports developed by Bahls (2001*a* and 2001*b*) stated that there maybe some organic enrichment and possible chronic metal toxicity in Nickel Creek. Another limiting factor is that the system is phosphorus limited, rather that nitrogen limited like most streams in the Upper Owyhee Watershed. Since Nickel Creek is spring feed, it would appear that phosphorus would be limited since natural bioavailable forms of phosphorus in ground waters are usually found in very low concentrations. This is further confirmed by the presence of rooted macrophytes where the only source of phosphorus is found in the sediment. Although the periphyton data indicates that sediment is not the most likely cause of impairment, the system does not have the algae-diatom species present that would indicate CWAL is supported. Further evaluation of the possible impairment causes is necessary.

Macroinvertebrate analyses showed severe impairment from sediment at this site based on very low EPT richness. In all likelihood, this impairment is due to poor substrate and habitat. The area where macroinvertebrates and periphyton samples were collected is an area of very slow flows in a wide but sometimes deep thalweg. Water velocity is not measurable in some sections. The few riffles located in this section were below the springs, and in general, the streambanks were degraded or eroding (Ingham 2001). The complicating factor of low velocity and eroding streambank will allow for any sediment that enter the system to stay in the area and not be moved through the system. This would cause embeddeness and a lack of CWAL species.

Table 19. Periphyton Results, Stream, Year, Indicator, Indices and Impairment. Upper Owyhee Watershed.

Biological Integrity Metric/ Water body	Diversity Index [a] (Shannon)	Pollution Index	Siltation Index	Disturbance Index	Number of Species Counted	Percent Dominance	Percent Abnormal
Blue Creek Reservoir							
July 2001							
Score	3.98	2.17	68.72	0.95	26	18.48	0.00
Indicator	Excellent	**Good**	**Poor**	Excellent	**Good**	Excellent	Excellent
Impairment	None	**Minor**	**Severe**	None	**Minor**	None	None
Juniper Basin Res.							
July 2001							
Score	3.25	1.47	82.51	0.99	19	35.97	0.00
Indicator	Excellent	**Poor**	**Poor**	Excellent	**Fair**	**Good**	Excellent
Impairment	None	**Severe**	**Severe**	None	**Moderate**	**Minor**	None
Deep Creek (DC-001)							
July 2000							
Score	4.44	2.39	72.60	0.59	42	16.13	0.00
Indicator	Excellent	Good	Poor	Excellent	Excellent	Excellent	Excellent
Impairment	None	**Minor**	**Severe**	None	None	None	None
Deep Creek (DC-002)							
July 2000							
Score	3.61	2.80	9.23	28.28	34	28.28	0.00
Indicator	Excellent	Excellent	Excellent	**Good**	Excellent	**Good**	Excellent
Impairment	None	None	None	**Minor**	None	**Minor**	None
Deep Creek (DC-003)							
July 2000							
Score	3.73	2.82	8.76	15.82	39	20.44	0.00
Indicator	Excellent	Excellent	Excellent	**Good**	Excellent	**Good**	Excellent
Impairment	None	None	None	**Minor**	None	**Minor**	None

Table 19. (Continued) Periphyton Results, Stream, Year, Indicator, Indices and Impairment. Upper Owyhee Watershed.

Biological Integrity Metric/ Water body	Diversity Index (Shannon)	Pollution Index	Siltation Index	Disturbance Index	Number of Species Counted	Percent Dominance	Percent Abnormal
Deep Creek (DC-001)							
Sept 2000							
Score	4.38	2.52	65.84	1.88	50	18.37	0.24
Indicator	Excellent	Good	Poor	Excellent	Excellent	Excellent	**Good**
Impairment	None	**Minor**	**Severe**	None	None	None	**Minor**
Deep Creek (DC-002)							
Sept 2000							
Score	3.65	2.66	8.49	36.00	37	36.00	0.00
Indicator	Excellent	Excellent	Excellent	**Good**	Excellent	**Good**	Excellent
Impairment	None	None	None	**Minor**	None	**Minor**	None
Deep Creek (DC-002)							
Sept 2000							
Score	2.94	2.82	2.85	36.82	24	36.82	0.00
Indicator	**Good**	Excellent	Excellent	**Good**	**Good**	**Good**	Excellent
Impairment	**Minor**	None	None	**Minor**	**Minor**	**Minor**	None
Deep Creek (DC-002)							
June 2001							
Score	3.94	2.61	23.62	6.00	38	26.32	0.00
Indicator	Excellent	Excellent	**Good**	Excellent	Excellent	**Good**	Excellent
Impairment	None	None	**Minor**	None	None	**Minor**	None
Deep Creek (DC-003)							
June 2001							
Score	4.17	2.54	30.05	3.09	40	17.10	0.00
Indicator	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Excellent
Impairment	None	None	Minor	None	None	None	None

Table 19. (Continued) Periphyton Results, Stream, Year, Indicator, Indices and Impairment. Upper Owyhee Watershed.

Biological Integrity Metric/ Water body	Diversity Index (Shannon)	Pollution Index	Siltation Index	Disturbance Index	Number Of Species Counted	Percent Dominance	Percent Abnormal
Deep Creek							
July 2001							
Score	4.28	2.48	61.39	0.96	42	19.42	0.00
Indicator	Excellent	Good	Poor	Excellent	Excellent	Excellent	Excellent
Impairment	None	Minor	Severe	None	None	None	None
Deep Creek (DC-002)							
July 2001							
Score	3.22	2.63	3.84	24.01	25	24.85	0.00
Indicator	Excellent	Excellent	Excellent	Excellent	**Good**	Excellent	Excellent
Impairment	None	None	None	None	**Minor**	None	None
Deep Creek (DC-003)							
July 2001							
Score	3.40	2.59	5.22	12.69	35	28.71	0.00
Indicator	Excellent	Excellent	Excellent	Excellent	Excellent	**Good**	Excellent
Impairment	None	None	None	None	None	**Minor**	None
Pole Creek							
2001							
Score	3.36	2.23	8.51	16.89	33	25.39	0.00
Indicator	Excellent	**Good**	Excellent	Excellent	Excellent	Excellent	Excellent
Impairment	None	**Minor**	None	None	None	None	None
Castle Creek							
June 2000							
Score	4.62	2.35	43.10	3.03	48	16.22	0.00
Indicator	Excellent	**Good**	**Fair**	Excellent	Excellent	Excellent	Excellent
Impairment	None	**Minor**	**Moderate**	None	None	None	None

Table 19. (Continued) Periphyton Results, Stream, Year, Indicator, Indices and Impairment. Upper Owyhee Watershed.

Biological Integrity Metric/ Water body	Diversity Index (Shannon)	Pollution Index	Siltation Index	Disturbance Index	Number Of Species Counted	Percent Dominance	Percent Abnormal
Castle Creek							
Sept 2000							
Score	3.89	2.36	40.29	28.47	41	28.47	0.00
Indicator	Excellent	**Good**	**Fair**	Excellent	Excellent	Good	Excellent
Impairment	None	**Minor**	**Moderate**	None	None	**Minor**	None
Castle Creek							
2001							
Score	4.69	2.33	38.65	5.59	19	35.97	0.00
Indicator	Excellent	**Good**	**Good**	Excellent	**Fair**	Good	Excellent
Impairment	None	**Minor**	**Minor**	None	**Moderate**	Minor	None
Red Canyon Creek							
2001							
Score	4.10	2.34	18.64	18.27	41	19.14	0.00
Indicator	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Excellent
Impairment	None	Minor	None	None	None	None	None

Table 20. Macroinvertebrate Data Analysis. Taxa Richness, EPT Assessment and Bioassessment Scores. Upper Owyhee Watershed.

Stream	Date	Taxa Richness	EPT Richness	Ephemeroptera Richness	Plecoptera Richness	Tricoptera Richness	Mean Bioassessment Score (n)[a]
Deep Cr-002	June 2000	49	16	8	0	8	4.4 (11)
	August 2000	47	16	8	1	7	4.4 (11)
Deep Cr-003	June 2000	50	11	5	1	5	4 (12)
Deep Cr-003	June 2000	47	13	8	0	5	4.8 (10)
	August 2000	37	09	3	0	6	3.4 (7)
Castle Creek	June 2000	39	14	8	1	5	4.1 (13)
	August 2000	29	06	3	0	3	4.0 (5)
Nickel Creek	June 2000	27	03	2	0	1	4.4 (5)
	August 2000	32	03	0	0	3	5.0 (3)

a Although all the data is important to show biodiversity for macroinvertebrates, the bioassessemt score indicates the species found are moderately tolerant to fine sediment. Studies cited in Clark (2002) show these species are found in streams where fine sediment (<6 mm) cover between 50-70% of the substrate (Relyea et al. 2000).

Bacteria Data

Applicable Bacteria Standards

In 2000, the state of Idaho adopted *E. coli* as the standard to determine if recreational uses are supported in the waters of the state. Past monitoring used fecal coliform as an indicator for the support or non-support of recreational uses. It was the use of fecal coliform data that Battle Creek and Shoofly Creek on the 1998 §303(d) list based on one time high readings that exceeded the past criteria for the support of either PCR or SCR. Studies have shown the use of fecal coliform bacteria may not have been the best indicator of bacteria or the presence of fecal type material. The current indicator bacteria, *E. coli*, are a better indicator of fecal type contamination and the presence of other bacteria that may pose a risk to public health.

The current criteria for determining if PCR or SCR uses are supported are found in IDAPA§ 58.01.02.251.01 and 02. The criteria are based on a one time sampling event, and/or a five sample set collected over a 30 day period to obtain a geometric mean. The WQS for the support of primary contact recreation states, **" Primary Contact Recreation"**. Waters designated for primary contact recreation are not to contain *E.coli* bacteria significant to the public health in concentrations exceeding:

a. For areas within waters designated for primary contact recreation that are additionally specified as public swimming beaches, a single sample of two hundred thirty-five (235) *E. coli* organisms per one hundred (100) ml. For the purpose of this subsection, "specified public swimming beaches" are considered to be indicated by features such as signs, swimming docks, diving boards, slides, or the like, boater exclusion zones, map legends, collection of a fee for beach use, or any other unambiguous invitation to public swimming. Privately owned swimming docks or the like which are not open to the general public are not included in this definition.

b. For all other waters designated for primary contact recreation, a single sample of four hundred six (406) *E.coli* organisms per one hundred (100) ml; or

c. A geometric mean of one hundred twenty-six (126) *E.coli* organisms per one hundred (100) mlbased on a minimum of five (5) samples taken every three (3) to five (5) days over a thirty (30) day period."

The WQS for the support of secondary contact recreation states, **"Secondary Contact Recreation"**. Waters designated for secondary contact recreation are not to contain *E.coli* bacteria significant to the public health in concentrations exceeding:

a. A single sample of five hundred seventy-six (576) *E.coli* organisms per one hundred (100) ml; or

b. A geometric mean of one hundred twenty-six (126) *E.coli* organisms per one hundred (100) ml based on a minimum of five (5) samples taken every three (3) to five (5) days over a thirty (30) day period.

Bacteria Impairments

E. coli is itself a pathogen and has been associated with a variety of gastrointestinal diseases. It may also indicate the presence of other waterborne diseases associated with viruses, protozoa or other bacteria. Some virus-associated diseases include hepatitis A and rotavirus. Diseases associated with protozoa include cryptosporidiosis and giardiasis. Waterborne bacterial diseases include typhoid fever and cholera.

Data Analysis

Battle Creek

The remoteness of access sites on Battle Creek greatly hampered the ability to gather samples in 2000 and 2001. Samples were collected at three sites in 2001. All samples were below the WQS criteria for the support of PCR and SCR. The results of the three (3) samples are shown in Table 21. Idaho DEQ will remove bacteria as a pollutant in Battle Creek on Idaho's 2002 §303(d) list.

Table 21. Bacteria Monitoring Results for Battle Creek, 2001. Upper Owyhee Watershed.

Station	Date	*E. coli* Number/100 ml
Battle Creek downstream of Big Spring Creek	July 10, 2001	12
Battle Creek upstream of Big Spring Creek	July 10, 2001	27
Battle Creek at Upper Crossing	July 10, 2001	90

Shoofly Creek

Two sampling sites were selected on Shoofly Creek in 2000. Since Shoofly Creek went dry upstream of Bybee Reservoir early in the season, it was not possible to get samples upstream. Samples were collected below Bybee Reservoir and both samples were below the WQS criteria for the support of PCR and SCR. Idaho DEQ will remove bacteria as a pollutant in Shoofly Creek on the 2002 Idaho §303(d) list. Table 22 shows the bacteria results for Shoofly Creek for 2000.

Table 22. Bacteria Results for Shoofly Creek, 2000. Upper Owyhee Watershed.

Station	Date	*E. coli* Number/100 ml
Shoofly Creek at Road Crossing	August 15, 2000	<1
Shoofly Creek below Bybee Reservoir	August 15, 2000	50

2.5 Data Gaps

The Upper Owyhee Watershed is a very remote area. From Boise, Idaho, it can take up to five hours to reach some monitoring sites. The sheer size of the watershed (over 1,000,000 acres), inaccessible areas and few roads are enough to hamper any scientific evaluation. None of the streams are land accessible during winter months or during periods of snowmelt. Even with a great deal of time invested evaluating streams, further evaluation could have enhanced the development of the Upper Owyhee Watershed SBA-TMDL.

Beneficial Use Status

Many of the water bodies listed on the §303(d) list for the Upper Owyhee Watershed are very remote, with many segments in areas not accessible by vehicles. These areas are in steep incised canyons that do not have access except for from an up or down stream location. More biological information (fish, macroinvertebrates, periphyton, etc.) would provide an overview of areas where current land use practices may or may not be impairing beneficial uses.

Temperature

Ideally more water temperature data should be collected on all systems within the Upper Owyhee Watershed, including listed and non-listed streams. Temperature data should be collected for a longer period and should take in periods when normal snowpack and precipitation events are occurring. Temperature monitoring on different segments (locations) of streams that were monitored would provide additional valuable data and would assist in water temperature model validation.

An analysis of the ground water influences in the Upper Owyhee Watershed would be extremely valuable. As described in the pollution source analysis, ground water may have a major impact in reducing surface water temperature. More information on the site potential for riparian vegetation is also lacking.

Sediment

With the large number of streams on the §303(d) list for sediment impairment, it was not possible to obtain the data to complete an accurate evaluation within the available time. The remoteness of the area and the inability to conduct year round water quality monitoring also hampered Idaho DEQ's ability to compare instream water quality (turbidity and suspended sediment) to the WQS.

Ideally, more stream embeddeness and percent fines surveys should be completed. These are very time consuming and resource intensive analyses. The streambed data presented in this document is limited to areas that are easily accessible.

Turbidity source analysis is identified as another data gap. It was not evaluated if the turbidity issues in the two reservoirs (Juniper Basin and Blue Creek) are an internal source or if the source is associated with activity in the watershed. Further analysis of the two watersheds will need to be completed along with a more in-depth analysis of reservoir management.

Hydrology

Historic stream flow measurements are nonexistent in the Upper Owyhee Watershed. It is recognized that the Owyhee Watershed is an arid area where frequent and sometime heavy precipitation events can affect the hydrology of the watersheds. Without historic or even current flow information, it is difficult to determine an accurate loading analysis or apply accurate and applicable WQS to certain segments (i.e. intermittent waters).

With the absence of flow data, "*Estimating Monthly and Annual Streamflow Statistics at Ungaged Sites in Idaho*" (Hortness and Berenbrock 2000) was used to determine discharge from selected watersheds (i.e. flow prediction models). This model was the only resource available to estimate flows in this region.

2.6 Non-Listed Water Quality Limited Segments and/or Additional Pollutant(s) of Concern

Battle Creek

Battle Creek was listed for impairment of recreational uses associated with bacteria. However, data obtained from the BLM for temperature indicated WQS were exceeded for the support of CWAL. The IDFG management plan includes management of the watershed for wild redband trout (IDFG 2001). Table 23 shows the statistical breakdown for temperature monitoring conducted by the BLM.

Table 23. Battle Creek Temperature Results, 1999 and 2000. Upper Owyhee Watershed.

Year and Critical Period	95th Percentile °C	Maximum °C	Minimum °C	Average °C
Battle Creek at Twin Bridges				
1999 July 14 thru August 31 Maximum Daily CWAL[a]	24.86	25.10	17.62	23.01
1999 July 14 thru August 31 Max. Daily Average CWAL	20.47	21.45	13.56	18.82
2000 July 7 thru August 31 Maximum Daily CWAL	27.83	30.16	18.49	24.90
2000 July 7 thru August 31 Max. Daily Average CWAL	21.44	21.97	15.76	19.60
Battle Creek at Upper Crossing				
1999 July 14 thru August 31 Maximum Daily CWAL	25.22	25.29	16.52	22.88
1999 July 14 thru August 31 Max. Daily Average CWAL	20.89	22.26	13.67	19.09

[a] Cold Water Aquatic Life

In 1999, at the upper road crossing site, the CWAL criterion for maximum daily temperature was exceeded 71% of all dates. The CWAL criterion for maximum daily average temperature was exceeded on 61% of all dates. For the Twin Bridges site, in 1999 the CWAL criterion for maximum daily temperature was exceeded on 84% of all dates. The CWAL criterion for maximum daily average temperature was exceeded on 51% of all dates. In 2000, at the Twin Bridge site, the CWAL criterion for maximum daily temperature was exceeded on 94% of all dates. The CWAL criterion for maximum daily average temperature was exceeded on 63% of all dates. A temperature TMDL will not be developed for Battle Creek at this time, but Idaho DEQ will place it on the next §303(d) list.

Nickel Creek

Nickel Creek is not listed for temperature. However, a Hobo® Temperature logger was placed in Nickel Creek with the idea it may be a possible reference site. During July through August 2000, the CWAL criteria were not exceeded. However, both temperature criteria for salmonid spawning were exceeded during June 1 through June 20, 2001. The 13 ^{o}C criterion was exceeded on 75% of the 20 dates with results. The 9 ^{o}C criterion was exceeded on 100% of the same dates. Due to operator error, the remainder of the salmonid spawning season cannot be evaluated.

A TMDL for temperature will not be developed at this time due to the minimal amount of data available. Idaho DEQ will list temperature as a pollutant of concern for Nickel Creek on the next Idaho §303(d) list.

Camas Creek

Camas Creek is a 3rd order tributary to Pole Creek. Through the assessment process of the Upper Owyhee Watershed the BLM has provided temperature data for the stream. This data showed 22% of the data from July 13th through August 31, 2000, exceeded the daily average temperature for the protection of CWAL. The IDFG management plan includes management of the watershed for wild redband trout (IDFG 2001). A TMDL for temperature will not be developed for Camas Creek at this time, but it will be added as a water quality limited segment on the next Idaho §303(d) list.

Additionally, the assessment process for the Water Body Assessment Guidance (Idaho DEQ 2002) showed the overall SMIs and SHIs scores indicated that CWAL is not full support. It is recommended a TMDL not be developed for Camas Creek at this time. However, the temperature loading analysis for Camas Creek as presented in Section 5.0 could be utilized as the basic framework for analysis. Additional information is required to determine possible other pollutants of concern. Camas Creek will be added as a Water Quality Limited Segment on the next Idaho DEQ §303(d) list.

Deep Creek

During the 2000 monitoring effort, large areas of filamentous algae were present within Deep Creek. With this in mind, further investigation of dissolved oxygen (DO) levels within the water column were needed. Instantaneous DO measurements showed DO sags occurring after sunset, even though temperatures dropped during the same period. In July 2001, 24-hour temperature / DO monitoring was conducted. The results are shown in Figure 10.

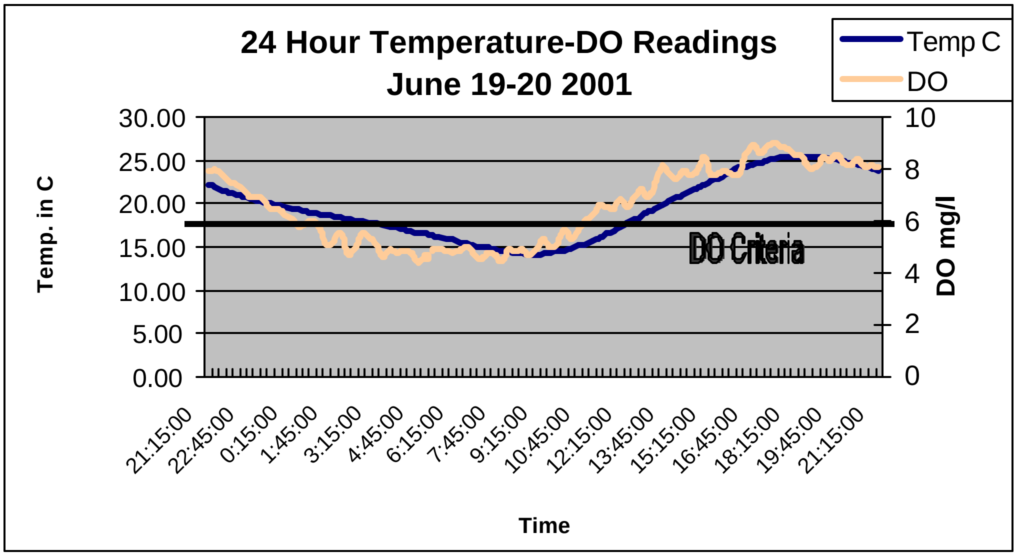


Figure 10. Twenty-four Hour Temperature Dissolved Oxygen Results, Deep Creek June 19-20, 2001. Upper Owyhee Watershed.

These results showed DO sags possibly associated with nuisance aquatic growth. That is, since water temperature was dropping at the same time, water column DO levels should have been rising. Since DO levels sagged during the period of respiration and once again raised during periods of photosynthesis, it is possible that algae growth was affecting water column DO levels. Water column monitoring did not indicate the presence of nutrients at levels that would usually cause nuisance aquatic growth. Further analysis of algae species would be beneficial in determining the nutrient fixing capability of the algae. However, since other indicators of respiration and photosynthesis (such as carbon and pH) were not evaluated, a TMDL will not be written to address DO at this time. Idaho DEQ will add DO as beneficial use impairment for the next cycle of the Idaho §303(d) list.

Camel Creek

Camel Creek is a 3rd order tributary to Pole Creek. The assessment process for the Water Body Assessment Guidance (Idaho DEQ 2002) showed the overall SMIs and SHIs scores for Camel Creek indicated that CWAL is not full support. It is recommended a TMDL not be developed for Camel Creek at this time.

Although there is indication that temperature is a pollutant of concern, there may be other pollutants impairing the beneficial uses. However, the temperature loading analysis for Camas

Creek as presented in Section 5.0 could be utilized as the basic framework for analysis. Additional information is required to determine possible pollutants of concern. Camel Creek will be added as a Water Quality Limited Segment on the next Idaho DEQ §303(d) list.

Beaver Creek

Beaver Creek is a 3rd Order stream that enters Deep Creek near the confluence with the East Fork of the Owyhee River. Beaver Creek originates on the eastside of Juniper Mountain and flows generally west to east. The assessment process for the Water Body Assessment Guidance (DEQ 2002) showed the overall SMIs and SHIs scores for Beaver Creek indicated that CWAL is not full support. It is recommended a TMDL not be developed for Beaver Creek at this time.

Although there is indication that temperature is a pollutant of concern, there may be other pollutants impairing the beneficial uses. However, the temperature loading analysis for Beaver Creek as presented in Section 5.0 could be utilized as the basic framework for analysis. Additional information is required to determine possible other pollutants of concern. Beaver Creek will be added as a Water Quality Limited Segment on the next Idaho DEQ §303(d) list.

Dry Creek

Dry Creek is a 2nd Order stream that flows into Battle Creek from the west. The headwaters originate from the Owyhee Mountains and the Antelope Flats area. The assessment process for the Water Body Assessment Guidance (Idaho DEQ 2002) showed the overall SMIs and SHIs scores for Dry Creek indicated that CWAL is not full support. A TMDL will not be developed for Dry Creek at this time. Dry Creek will be placed on the next §303(d) list as a Water Quality Limited Segment. Pollutant(s) of concern are not known at this time. Existing beneficial uses are also unknown. However, the IDFG management plan includes management of the watershed for wild redband trout (IDFG 2001).

Nickel Creek (Salmonid Spawning Temperature and Metals)

Nickel Creek is not listed for temperature. However, a Hobo® Temperature logger was placed in Nickel Creek with the idea it may be a possible reference site. During the period from July through August of 2000 the CWAL criteria were not exceeded. During the spring of 2001, June 1 through June 20, both temperature criteria for salmonid spawning were exceeded. The 13^{o}C criterion was exceeded on 75% of the twenty dates with results. The 9^{o}C criterion was exceeded on 100% of the same dates. Due to operator error, the remainder of the salmonid spawning season cannot be evaluated. A TMDL for temperature will not be developed at this time due to the minimal amount of data available. Idaho DEQ will list temperature as a pollutant of concern for Nickel Creek on the next Idaho DEQ §303(d) list. However, the temperature loading analysis for Nickel Creek as presented in Section 5.0 could be utilized as the basic framework for analysis.

Periphyton data and interpretation of that data indicated that there may be a chronic toxic metal issue in Nickel Creek. Since this was not a pollutant of concern on the 1998 §303(d) list, it was not a parameter that was monitored for. It is recommended that metal be placed as pollutant of concern for the next cycle for the §303(d) listing process. It is currently felt that there is not enough information to proceed with a TMDL to address metals as a pollutant of concern and develop a TMDL.

Recommendations

Table 24 is a list of actions that will occur on Water Quality Limited segments in the Upper Owyhee Watershed (HUC 17050104).

Table 24. Action Items for Water Quality Limited Segments. Upper Owyhee Watershed.

Stream Name	Action for TMDL and Next Idaho §303(d) list	Pollutant(s) of Concern For TMDL and/or Future Listing	Uses Impaired
Blue Creek Reservoir	Develop TMDL	Sediment	CWAL[c], SS[d]
Juniper Basin Reservoir	UAA[a] & Propose Modified Aquatic Life Use	Sediment	NA
Deep Creek	Develop TMDL, List for DO[b]	Temperature, Sediment, Organic Enrichment, DO	CWAL, SS
Pole Creek	Develop TMDL	Temperature	CWAL, SS
Castle Creek	Develop TMDL	Temperature, Sediment	CWAL, SS
Red Canyon Creek	Develop TMDL	Temperature	CWAL, SS
Nickel Creek	Develop TMDL, List for Temperature and Metals	Sediment, Temperature and Metals	CWAL, SS
Battle Creek	De-List for Bacteria, List for Temperature	Temperature	CWAL, SS
Shoofly Creek	De-List for Bacteria, De-List as Impaired Water Body	NA	NA
Camas Creek	List on Next §303(d) list	Temperature	CWAL, SS
Camel Creek	List on Next §303(d) list	As per the WBAG II	Unknown
Beaver Creek	List on Next §303(d) list	As per the WBAG II	Unknown
Dry Creek	List on Next §303(d) list	As per the WBAG II	Unknown

Use Atainabiltity Analysis, b. Dissolved Oxygen, c. Cold Water Aquatic Life, d. Salmonid Spawning

Table 25 lists recommended designated beneficial uses to be placed in IDAPA§ 58.02.01.140 for the Upper Owyhee Watershed.

Table 25. Recommendation of Designated Beneficial Uses. Upper Owyhee Watershed.

Stream Name	Recommendation for Designated Uses
Blue Creek Reservoir	CWAL[a], PCR[b]
Juniper Basin	Modified Aquatic Life Use, PCR
Deep Creek	CWAL, SS[c], PCR
Pole Creek	CWAL, SS, PCR
Castle Creek	CWAL, SS, PCR
Red Canyon Creek	Established Designated Uses and SS
Nickel Creek	CWAL, SS, PCR
Battle Creek	CWAL, SS, PCR
Shoofly Creek	CWAL, SS, PCR

a.Cold Water Aquatic Life, b. Primary Contact Recreation, c. Salmonid Spawning

3. Subbasin Assessment – Pollutant Source Inventory

3.1 Point Sources

There are no point source discharges in the Upper Owyhee Watershed.

3.2 Nonpoint Sources

Temperature

There are many natural factors that can affect water temperature. These natural factors are known as drivers, which may include topographic shading, upland vegetation, precipitation, air temperature, wind speed, solar angle cloud cover, relative humidity, phreatic ground water temperature and discharge, and tributary temperature and flow (Poole and Berman 2000). It is when the influence of anthropogenic sources alters the ecological drivers and other physical characteristic that an out-of-balance heat exchange can occur.

Some of the physical factors affecting the drivers in the Upper Owyhee Watershed may include removal of adequate stream cover (riparian vegetation), upland vegetation changes (ground water infiltration) and stream morphology degradation (increased width-depth ratio, floodplain access). Along with physical factors, there are climatic factors that should be considered, such as snowmelt, ambient air temperature and precipitation. During 2000 and 2001 precipitation for the Upper Owyhee Watershed was below normal, both in yearly snowpack and summertime precipitation. These climatic conditions can alter the amount of flow, which will affect water temperature (Poole and Berman 2000).

High water temperatures in the Upper Owyhee Watershed appear to be associated with solar radiation, ambient air temperature and lack of ground water influence. All can have a direct or indirect effect on water temperature and can be influenced by a variety of physical attributes and stream-riparian conditions.

Solar radiation is the direct impact of solar energy on water. Different conditions can alter the amount of solar radiation reaching the water surface or the amount of water surface available to solar radiation. Reducing shading or stream cover has been shown to increase the water temperature (Teti 1998). Brown (1970) showed solar radiation on water surfaces was the greatest factor in high water temperature during critical summertime periods. The other physical characteristic affecting solar radiation is the amount of surface area exposed. A wide shallow stream allows for more surface area to be affected by solar radiation (width-depth ratio).

Lack of adequate stream (canopy) cover can affect the heat transfer from water to air. Stream cover provides a buffering capability for the interaction between water surface and the ambient air by reducing wind speed over water surface. It can also affect the relative humidity near the water surface, which affects the degree of heat transfer. Water evaporation rates increase when there is greater wind speed and solar radiation. This condition will reduce the amount of available water within the stream channel.

Ground water influences have been altered in many of the C channel type streams in the Upper Owyhee Watershed. These stream types are usually associated with low gradient (<2%) wet meadow type hydrologic conditions. As many of these systems down-cut into finer course material, ground water levels in the adjacent areas lower dramatically. In some areas these down-cuts have deepened the stream channel 3-6 meters below what was once the historic stream elevation. Old stream channels are evident in many of the low gradient stream areas. With the downcutting into these systems, there is a loss of the ability of the stream to have access to the historic floodplain and the ground water storage these systems are capable of achieving (Thomas et al. 1998). As these areas down-cut, ground water also retreated to a base flow and was greatly reduced once the stream hit a less erodible material, such as bedrock or hardpan. With this natural geological material, ground water storage is inadequate to provide crucial recharge during summertime flows, altering both the flow and water temperature.

Another factor to be considered is the effect on the hyporheic flow condition (below streambed flow). The hyporheic flow relies on the ability of streams to form pools and riffles, and the near benthic area of the stream to cool water for surface water. As water enters a pool or a meander, there is a natural driver for surface water to be forced into the ground. Ground water will follow gravity and flow downstream and reenter the stream at a lower or equal elevation from which it entered. As the ground water passes through alluvial soils, it is cooled to the ambient soil temperature (Wroblicky et al. 1996; Stanford, Ward and Ellis 1994).

As many of the streams in the Upper Owyhee Watershed down-cut, the natural capability to form meanders and adequate riffle-pool ratio diminishes. This indicates these streams have also lost the natural hyporheic flow driver for water temperature buffering. Stream sinuosity and the presence of geomorphic features are other factors in stream and hyporheic flow conditions. The lack of an adequate floodplain, side channels and backwaters are critical influences for hyporheic flows and water temperature (Poole and Berman 2000).

As described by Dupont (1999*a*), the current down-cutting of the streams in the North and Middle Fork Owyhee Watersheds is probably not entirely associated with current land use practices, but with the removal of beavers from the area (Idaho DEQ 1999*c*). The removal of beavers and the lack of maintenance of their dams allowed streams to down-cut into the course material that were, at one time, held back by beaver activity. This is also true for those streams in the Upper Owyhee Watershed.

This downcutting occurred until the stream met a more stable substrate (i.e., bedrock, hardpan), then stabilized. Under natural conditions, the stream will slowly regain access to the historic floodplain, building back up through the deposition of fine material during high flows. The presence of adequate vegetation is critical during this process for reducing stream velocity and providing streambank protection (Thomas et al. 1998).

Sediment

Sediment sources in the Upper Owyhee Watershed can vary from streambank erosion, overland flow, wind blown deposition, and instream channel transport. There is little information on any sources that can provide a quantitative estimate of the delivery rate to streams showing sediment is impairing the existing uses. However, studies have shown a direct impairment of aquatic biota communities and sediment from associated land use practices (Strand and Merritt 1999).

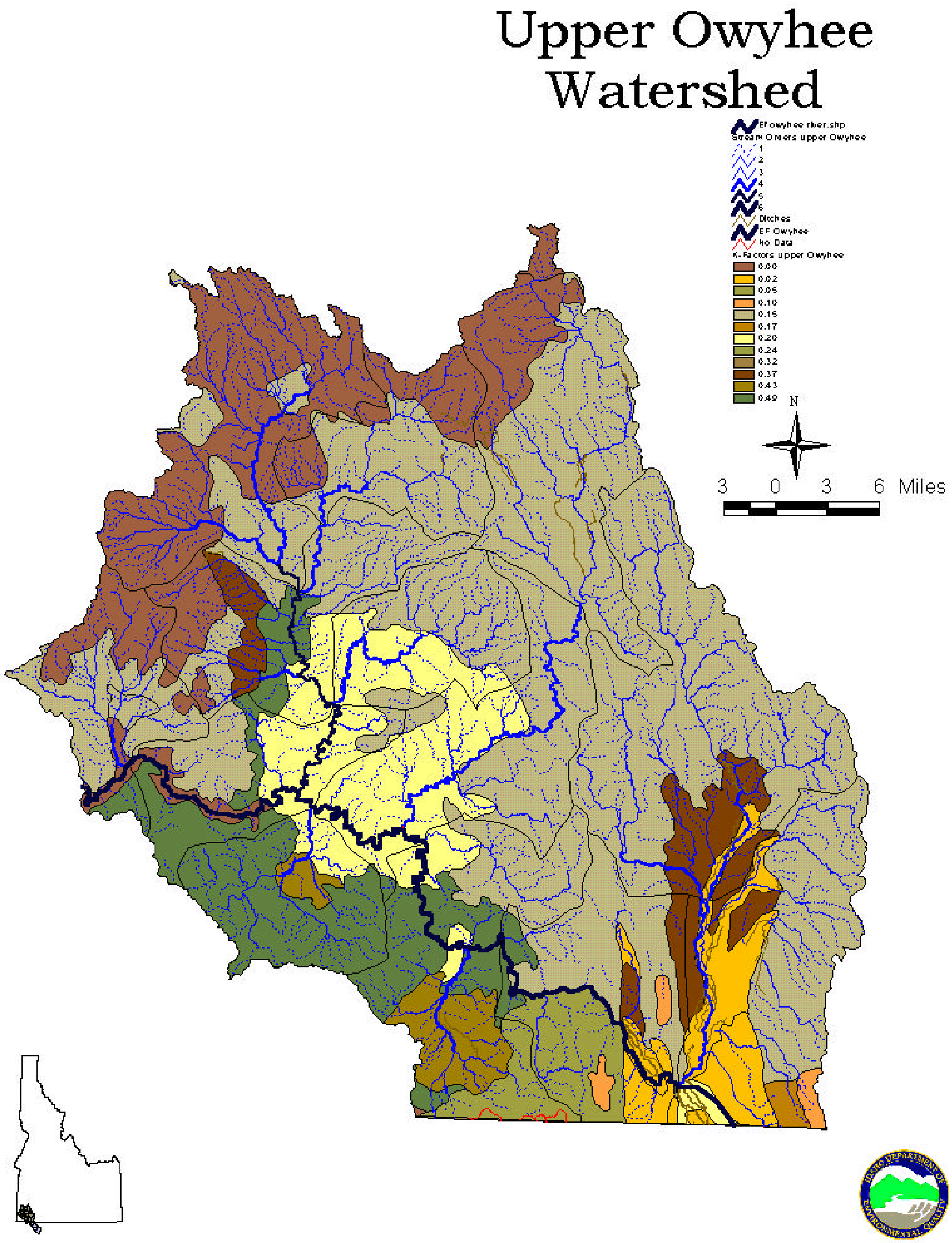
Overland flow usually consists of gully erosion, mass wasting and general surface erosion. Since there is a certain amount of overland flow sediment that gets tied up in hillside storage, it is very difficult to determine the exact delivery rate to water bodies from this source. The Natural Resources Conservation Service (NRCS) has determined the erosion factors for many areas in Owyhee County, including the Upper Owyhee Watershed. One factor in determining erosion is the K-Factor, or the measure of soil erodibility as affected by intrinsic soil properties (National Sedimentation Laboratory 2002). Along with other factors such as slope, slope length, cover and erosivity of the climate, a determination of average annual soil loss can be determined based on tons/acre/year.

Low K values, (0.05-0.15) where soils are mostly high in clay content and are more resistant to detachment, are typically the least erodible. Silt-loam soils are more easily detached and have a K value of greater than 0.4. Table 26 shows the percent and total number of acres that demonstrate certain K values in the Upper Owyhee Watershed. Figure 11 shows a schematic of K-Values in the watershed.

Table 26. K Values and Acreage Percent. Upper Owyhee Watershed.

K-Value Factor*	Erodibility	Acres*	Percent*
0.0	Low	157,628	14.8%
0.02	Low	43,143	4.1%
0.05	Low	32,971	3.1%
0.1	Low	7,100	0.7%
0.15	Low	498,904	46.9%
0.17	Medium	3,081	0.3%
0.2	Medium	105,051	9.9%
0.24	Medium	4,642	0.4%
0.32	Medium	20,742	1.9%
0.37	Medium	42,598	4.0%
0.42	High	49,645	4.7%
0.49	High	99,222	9.3%
Total		1,064,727	100%

aData obtained from USDepartment of Agriculture –Natural Resource Conservation Service STATSGO database. Some acreage are within Nevada and not delinated.



Data obtained from USDA-NRCS STATSGO database.

Figure 11. Erosion K-Factors. Upper Owyhee Watershed.

Slope of the land and other variables such as precipitation, wind erosion, the erosion potential of soils and other natural factors can also affect overland erosion. In the case of the Upper Owyhee Watershed, slope does not appear to be a critical factor in overland erosion. Table 27 shows percent slopes acreage within the Upper Owyhee Watershed along with the percentage the slope covers in the watershed. The percent slope was obtained from the weighted average per the map unit ID obtained from state soil geographic database (STATSGO). The table represents an overall average for the area.

Table 27. Slope, Acreage[a] and Percent. Upper Owyhee Watershed.

Slope (%)	<5%	> 5% and <10%	>10% and <15%	>15% and <20%	> 20% and <25%	>25%	Total
Acreage	49,747	198,815	8,995	736,655	5,909	11,982	1,012,103
% of Total	4.9%	18.6%	0.9%	72.8%	0.6%	11.8%	109.60%

aTotal acres from K Factor values differ due to calculation factors of GIS-STATGO layers.

The Owyhee Resource Management Plan (ORMP) (BLM 1999) identified those areas with a slope exceeding 30%, a K-Factor value of greater than 0.43 and wind erodible group (WEG) value of less than 4 as critical areas for high soil erosion. Less than 1% of the land in the Upper Owyhee Watershed had a WEG of less than 4. The ORMP does not provide much detail on the overall critical areas for high soil erosion areas within the Upper Owyhee Watershed, but does identify areas within some land use areas where current practices have high soil erosion potential within in the BLM management area. Since the Upper Owyhee Watershed takes in a small percentage of the area addressed in the ORMP (east of Deep Creek) the critical soil erosion areas appear, but are much less frequent in the remainder of the Upper Owyhee Watershed.

Smaller subwatersheds (1st and 2nd order streams) provide some sediment load to the larger streams that are listed for sediment as a pollutant of concern. However, since many of these smaller watersheds only provide sediment input during snowmelt and storm events, it is very difficult to determine actual sediment loads from these subwatersheds.

Review of aerial or LANSTATS photos do not indicate that mass wasting or roads are critical factors or sources of sediment in the Upper Owyhee Watershed. The road density in the watershed is so low that the use of current Geographical Information System (GIS) databases cannot determine density.

Although not easily quantified, streambank erosion can be significant source of sediment. As seen in Figures 12 and 13, sediment from streambank erosion provides a continuous source of sediment.

Figure 12. Deep Creek near Mud Flat Road. Upper Owyhee Watershed.

Figure 13. Deep Creek near Castle Creek Confluence. Upper Owyhee Watershed.

Stream geomorphology changes associated with beaver removal started in the late 1700s and early 1800s. The removal of the beaver population probably continued until the area was depleted or was no longer profitable. Even in the early 1900s the state of Idaho noted the depleted beaver population and prohibited the taking of beavers until 1957 (Platts and Onishuk 1988). In the early 1860s, a more extensive and permanent presence of man is documented, along with the current land use practices. As described earlier, the riparian areas were the most productive lands and were used for farming and ranching (Adams 1986).

The use of the vegetation along riparian corridors can be directly related to streambank erosion (Mosely et al. 1997, Platts and Nelson 1985, Platts 1979). This is especially evident in old C channel (Figure 14) types or in wet meadows where downcutting has occurred and access to the historic floodplain has been lost. Figure 15 shows the development of a "nick point" upstream of a down-cut area on Castle Creek.

Measurement of streambank erosion is easily quantifiable with direct evaluation of critical areas. Goals and objectives can be set that reflect conditions for reduction of sediment loads on those streams showing impairment from sediment.

Figure 14. Pole Creek near Mud Flat Road. Upper Owyhee Watershed.

In-channel storage and transport of sediment is a naturally occurring process. It is when the sediment load is out of balance with the natural sediment load balance, that impairment happens to the natural hydrology functions. It should be noted that the Upper Owyhee Watershed is a semi-arid climate and heavy, but brief precipitation events take place. However, with the removal of vegetation along stream riparian areas, these events have a detrimental effect and can exacerbate streambank erosion.

In-stream sediment can be measured a variety of ways: percent fines, pool volume, thalweg profile and cobble embeddeness.

Figure 15. Nick-point on Castle Creek. Upper Owyhee Watershed.

4. Subbasin Assessment – Summary of Past, Present and Implementation Strategy for Pollution Control Efforts

4.1 Point Sources

There are no point sources in the Upper Owyhee Watershed.

4.2 Nonpoint Sources

The state has responsibility under Sections 401, 402 and 404 of the CWA to provide water quality certification. Under this authority, the state reviews dredge and fill, stream channel alteration and National Pollutant Discharge Elimination System (NPDES) permits to ensure the proposed actions will meet the state of Idaho WQS.

Under Section 319 of the CWA, each state is required to develop and submit a nonpoint source management plan (NSMP). Idaho's NSMP has been submitted to the EPA and has been approved (Idaho DEQ 1999*b*). The NSMP identifies programs for implementation of BMPs, identifies available funding sources and includes a schedule for program milestones. It is certified by the state of Idaho Attorney General to ensure adequate authorities exist to implement the NSMP.

Idaho's NSMP describes many of the voluntary and regulatory approaches the state will take to abate nonpoint source pollution. Section 39-3601, et seq., includes provisions for public involvement, such as the formation of Basin Advisory Groups (BAG) and Watershed Advisory Groups (WAG) (IDAPA§ 58.01.02.052). The WAGs are established in high priority watersheds to assist Idaho DEQ and other state agencies in formulating specific actions needed to control point and nonpoint sources of pollution affecting water quality limited segments. A WAG was formed to assist with the *North and Middle Fork Owyhee Subbasin Assessment and Total Maximum Daily Load* (Idaho DEQ 1999*c*) and implementation plan. It is proposed this WAG be used as the main stakeholder contact for the Upper Owyhee Watershed TMDL and its implementation plan. This implementation plan must be completed within 18 months after approval of the TMDL.

The state of Idaho uses a voluntary approach to control agricultural nonpoint sources. However, regulatory authority can be found in the WQS (IDAPA§ 58.01.02.350.01 through 58.01.02.350.03). IDAPA§ 58.01.02.054.07 refers to the Idaho Agricultural Pollution Abatement Plan (Ag Plan) which provides direction to the agricultural community-approved BMPs (IDA-SCC 1993). A portion of the Ag Plan outlines responsible agencies or elected groups (Soil Conservation Districts [SCDs]) who will take the lead if nonpoint source pollution problems need to be addressed. For agriculture, it assigns the local SCDs to assist the land owner/operator with developing and implementing BMPs to abate nonpoint source pollution associated with the land use. If a voluntary approach does not succeed in abating the pollutant problem, the state may seek injunctive relief for those situations that may be determined to be an imminent and substantial danger to public health or environment (IDAPA§ 58.01.02.350.02(a)).

The Idaho WQS specify if water quality monitoring indicates WQS are not being met, even with the use of BMPs or knowledgeable and reasonable practices, the state may request the designated agency evaluate and/or modify the BMPs to protect beneficial uses. If necessary, the state may seek injunctive or other judicial relief against the operator of a nonpoint source activity in accordance with the Idaho DEQ Director (Section 39-108, Idaho Code) and (IDAPA§ 58.01.02.350).

The WQS list designated agencies responsible for reviewing and revising nonpoint source BMPs. Designated agencies are Department of Lands for timber harvest activities, oil and gas exploration and development and mining activities; the Soil Conservation Commission (SCC) for grazing and agricultural activities; the Department of Transportation for public road construction; the Department of Agriculture (IDA) for aquaculture; and Idaho DEQ for all other activities (IDAPA§ 58.01.02.003). The Idaho WQS refer to existing authorities to control nonpoint source pollution sources in Idaho. Some of these authorities and responsible agencies are listed in Table 28.

Table 28. Regulatory Authority for Nonpoint Pollution Sources. Upper Owyhee Watershed.

Nonpoint Source BMPs	Primary Responsible Agency or Agencies	Code/Regulation or Authority Involved
Idaho Forest Practice Rules	Idaho Department of Lands, Board of Land Commissioners	Idaho Code §39-3602, IDAPA§ 58.01.02.003.62, IDAPA§ 58.01.02.350.03
Rules Governing Solid Waste Management	Idaho Department of Environmental Quality and the Health Districts	IDAPA§ 58.01.02.350.03(b)
Rules Governing Subsurface and Individual Sewage Disposal Systems	Idaho Department of Environmental Quality and the Health Districts	Idaho Code §39-3602, IDAPA§ 58.01.02.350.03(c), IDAPA§ 58.01.15
Rules and Standards for Stream-channel Alteration	Board of Water Resources	IDAPA§ 58.01.02.350.03(d)
Rules Governing Exploration and Surface Mining Operations in Idaho	Idaho Department of Lands, Board of Land Commissioners	Idaho Code §39-3602, IDAPA§ 58.01.02.350.03(e), IDAPA§ 58.01.02.003.62
Rules Governing Placer and Dredge Mining in Idaho	Idaho Department of Lands, Board of Land Commissioners	IDAPA§ 58.01.02.350.03(f)
Rules Governing Dairy Waste	Idaho Department of Agriculture	IDAPA§ 58.01.02.350.03.(g) or IDAPA§ 58.01.02.04.14

The BIA and the Shoshone-Paiute Tribes are responsible for administering, managing and protecting approximately 12.1% (122,375 acres) of all lands within the Upper Owyhee Watershed (Duck Valley Indian Reservation, Idaho). Tribal WQS and/or the EPA determine if any water quality limited segments are present within tribal boundaries. Any control actions will also be the responsibility of the BIA/ Shoshone-Paiute Tribes and/or the EPA.

The BLM is responsible for administering, managing and protecting approximately 73.8% (746,833 acres) of the land in the Upper Owyhee Watershed. The agency has authority to regulate, license and enforce land use activities that affect nonpoint source pollution control from the Taylor Grazing Act, the federal CWA, the Federal Land and Policy Management Act, the Public Rangelands Improvement Act, the National Environmental Policy Act, the Emergency Wetlands Resource Act, the Agricultural Credit Act, the Land and Water Conservation Act and the Executive Orders for Floodplain Management and Protection of Wetlands.

The BLM is active in several interagency efforts to integrate priorities and provide implementation opportunities and tools for nonpoint source activities, such as the State Technical Committee, State BMP Committee, Coordinated Resource Management Plan (CRMP) Committee, and Agricultural TMDL Action Committee. The BLM participates in several §319 grants statewide for prevention and control of nonpoint source pollution.

Past management activities by the BLM in this subbasin include some livestock exclusion from riparian areas, pasture management with planned grazing systems, reservoir development, spring or water development in uplands and streambank protection. The *Owyhee Resource Management Plan and Final Environmental Impact Statement* (ORMP) includes pollution control activities that will be implemented over the next several years (BLM 1999). This document only affects the portion of the watershed from Deep Creek west to the Oregon state line. The selected alternative includes grazing management, which is meant to attain proper functioning and satisfactory riparian conditions and meet or exceed Idaho WQS in streams within the described portions of the Upper Owyhee Watershed. Examples of potential management activities are proper timing of grazing to minimize soil erosion, grazing management that provides adequate residual stubble height and proposed funding for range development projects to support management adjustments over a 20- year period.

4.3 Implementation Strategies

Overview

The purpose of this implementation strategy is to outline the pathway by which a larger, more comprehensive, implementation plan will be developed 18 months after TMDL approval. The comprehensive implementation plan will provide details of the actions needed to achieve load reductions (set forth in a TMDL), a schedule of those actions, and specify monitoring needed to document actions and progress toward meeting state water quality standards. These details are typically set forth in the plan that follows approval of the TMDL. In the meantime, a cursory implementation strategy is developed to identify the general issues such as responsible parties, a time line, and a monitoring strategy for determining progress toward meeting the TMDL goals outlined in this document.

The geographic scope of this TMDL effort encompasses the entire Upper Owyhee Watershed 4th Field HUC, 17050104. The water bodies to be addressed include Castle Creek, Red Canyon Creek, Deep Creek, Nickel Creek, Pole Creek, Juniper Basin Reservoir, and Blue Creek Reservoir. These water bodies and the pollutants to be addressed in the Implementation Plan are located in Table 22. Section 1.1 describes the water bodies and the listed segments.

Responsible Parties

Development of the final implementation plan for the Upper Owyhee Watershed TMDL will proceed under the existing practice established for the state of Idaho. The plan will be cooperatively developed by Idaho DEQ, the Owyhee WAG, and other "designated agencies" with input from the established public process. Of the three entities, the WAG will act as the integral part of the implementation planning process to identify appropriate implementation measures. Other individuals may also be identified to assist in the development of the site-specific implementation plans as their areas of expertise are identified as beneficial to the process. Together, these entities will recommend specific control actions and will then, with the BAG, review the specific implementation plan before submitting it to Idaho DEQ. Idaho DEQ will act as a repository for approved implementation plans.

Designated state agencies are responsible for assisting with preparation of specific implementation plans, particularly for those sources for which they have regulatory authority or programmatic responsibilities. Idaho's designated state management agencies are located on Table 26.

To the maximum extent possible, the implementation plan will be developed with the participation of federal partners and land management agencies (i.e., NRCS, U.S. Forest Service, BLM, Bureau of Reclamation, etc.). In Idaho, these agencies, and their federal and state partners, are charged by the CWA to lend available technical assistance and other appropriate support to local efforts/projects for water quality improvements.

All stakeholders in the Upper Owyhee Watershed subbasin have a responsibility for implementing the TMDL. Idaho DEQ and the "designated agencies" in Idaho have primary responsibility for overseeing implementation in cooperation with landowners and managers. Their general responsibilities are outlined below.

- **Idaho DEQ** will oversee and track overall progress on the specific implementation plan and monitor the watershed response. Idaho DEQ will also work with local governments on urban/suburban issues.
- **IDL** will maintain and update approved BMPs for forest practices and mining. IDL is responsible for ensuring use of appropriate BMPs on state and private lands.
- **ISCC**, working in cooperation with local Soil and Water Conservation Districts and ISDA, the NRCS will provide technical assistance to agricultural landowners. These agencies will help landowners design BMP systems appropriate for their property, and identify and seek appropriate cost-share funds. They also will provide periodic project reviews to ensure BMPs are working effectively.

The designated agencies, WAG, and other appropriate public process participants are expected to:

- Develop BMPs to achieve LAs
- Give reasonable assurance that management measures will meet LAs through both quantitative and qualitative analysis of management measures
- Adhere to measurable milestones for progress
- Develop a timeline for implementation, with reference to costs and funding
- Develop a monitoring plan to determine if BMPs are being implemented, individual BMPs are effective, LA and WLA are being met, and water quality standards are being met

In addition to the designated agencies, the public, through the WAG and other equivalent processes, will be provided with opportunities to be involved in developing the implementation plan to the maximum extent practical. Public participation will significantly affect public acceptance of the document and the proposed control actions. Stakeholders (landowners, local governing authorities, taxpayers, industries, and land managers) are the most educated regarding the pollutant sources and will be responsible for implementing the control actions identified in the plan. Experience has shown that the best and most effective implementation plans are those that are developed with substantial public cooperation and involvement.

Adaptive Management Approach

The goal of the CWA and its associated administrative rules for Idaho is that water quality standards shall be met or that all feasible steps will be taken towards achieving the highest quality water attainable. This is a long-term goal in this watershed, particularly because nonpoint sources are the primary concern. To achieve this goal, implementation must commence as soon as possible.

The TMDL is a numerical loading that sets pollutant levels such that instream water quality standards are met and designated beneficial uses are supported. Idaho DEQ recognizes that the TMDL is calculated from mathematical models and other analytical techniques designed to simulate and/or predict very complex physical, chemical, and biological processes. Models and some other analytical techniques are simplifications of these complex processes and, while they are useful in interpreting data and in predicting trends in water quality, they are unlikely to produce an exact prediction of how streams and other waterbodies will respond to the application of various management measures. It is for this reason that the TMDL has been established with a MOS.

For the purposes of the Upper Owyhee Watershed TMDL, a general implementation strategy is being prepared for EPA as part of the TMDL document. Following this submission, in accordance with approved state schedules and protocols, a specific detailed implementation plan will be prepared for pollutant sources.

For nonpoint sources, Idaho DEQ also expects that implementation plans be implemented as soon as practicable. However, Idaho DEQ recognizes that it may take some period of time, from several years to several decades, to fully implement the appropriate management practices. Idaho DEQ also recognizes that it may take additional time after implementation has been accomplished before the management practices identified in the implementation plans become fully effective in reducing and controlling pollution. In addition, Idaho DEQ recognizes that technology for controlling nonpoint source pollution is, in many cases, in the development stages and will likely take one or more iterations to develop effective techniques. It is possible that after application of all reasonable best management practices, some TMDLs or their associated targets and surrogates cannot be achieved as originally established. Nevertheless, it is Idaho DEQ's expectation that nonpoint sources make a good faith effort to achieving their respective load allocations in the shortest practicable time.

Idaho DEQ recognizes that expedited implementation of TMDLs will be socially and economically challenging. Further, there is a desire to minimize economic impacts as much as possible when consistent with protecting water quality and beneficial uses. Idaho DEQ further recognizes that, despite the best and most sincere efforts, natural events beyond the control of humans may interfere with or delay attainment of the TMDL and/or its associated targets and surrogates. Such events could be, but are not limited to floods, fire, insect infestations, and drought.

For some pollutants, pollutant surrogates have been defined as targets for meeting the TMDLs. The purpose of the surrogates is not to bar or eliminate human access or activity in the basin or its riparian areas. It is the expectation, however, that the specific implementation plan will address how human activities will be managed to achieve the water quality targets and surrogates. It is also recognized that full attainment of pollutant surrogates (system potential vegetation, for example) at all locations may not be feasible due to physical, legal, or other regulatory constraints. To the extent possible, the implementation plan should identify potential constraints, but should also provide the ability to mitigate those constraints should the opportunity arise. If a nonpoint source that is covered by the TMDL complies with its finalized implementation plan, it will be considered in compliance with the TMDL.

Idaho DEQ intends to regularly review progress of the implementation plan. If Idaho DEQ determines the implementation plan has been fully implemented, that all feasible management practices have reached maximum expected effectiveness, but a TMDL or its interim targets have not been achieved, Idaho DEQ shall reopen the TMDL and adjust it or its interim targets and the associated water quality standard(s) as necessary.

The implementation of TMDLs and the associated plan is enforceable under the applicable provisions of the water quality standards for point and nonpoint sources by Idaho DEQ and other state agencies and local governments in Idaho. However, it is envisioned that sufficient initiative exists on the part of local stakeholders to achieve water quality goals with minimal enforcement. Should the need for additional effort emerge, it is expected that the responsible agency will work with land managers to overcome impediments to progress through education, technical support, or enforcement. Enforcement may be necessary in instances of insufficient action towards progress. This could occur first through direct intervention from state or local land management agencies, and secondarily through Idaho DEQ. The latter may be based on departmental orders to implement management goals leading to water quality standards.

In employing an adaptive management approach to the TMDL and the implementation plan, Idaho DEQ has the following expectations and intentions:

- Subject to available resources, Idaho DEQ intends to review the progress of the TMDLs and the implementation plans on a five-year basis.
- Idaho DEQ expects that designated agencies will also monitor and document their progress in implementing the provisions of the implementation plans for those pollutant sources for which they are responsible. This information will be provided to Idaho DEQ for use in reviewing the TMDL.
- Idaho DEQ expects that designated agencies will identify benchmarks for the attainment of TMDL targets and surrogates as part of the specific implementation plans being developed. These benchmarks will be used to measure progress toward the goals outlined in the TMDL.
- Idaho DEQ expects designated agencies to revise the components of their implementation plan to address deficiencies where implementation of the specific management techniques are found to be inadequate.
- If Idaho DEQ, in consultation with the designated agencies, concludes that all feasible steps have been taken to meet the TMDL and its associated targets and surrogates, and that the TMDL, or the associated targets and surrogates are not practicable, the TMDL may be reopened and revised as appropriate. Idaho DEQ would also consider reopening the TMDL should new information become available indicating that the TMDL or its associated targets and/or surrogates should be modified.

Monitoring and Evaluation

The objectives of a monitoring effort are to demonstrate long-term recovery, better understand natural variability, track implementation of projects and BMPs, and track effectiveness of TMDL implementation. This monitoring and feedback mechanism is a major component of the "reasonable assurance of implementation" for the TMDL implementation plan.

The implementation plan will be tracked by accounting for the numbers, types, and locations of projects, BMPs, educational activities, or other actions taken to improve or protect water quality. The mechanism for tracking specific implementation efforts will be annual reports to be submitted to Idaho DEQ.

The "monitoring and evaluation" component has two basic categories:
- Tracking the implementation progress of specific implementation plans; and
- Tracking the progress of improving water quality through monitoring physical, chemical, and biological parameters.

Monitoring plans will provide information on progress being made toward achieving TMDL allocations and achieving water quality standards, and will help in the interim evaluation of progress as described under the adaptive management approach.

Implementation plan monitoring has two major components:
- Watershed monitoring and

- BMP monitoring.

While Idaho DEQ has primary responsibility for watershed monitoring, other agencies and entities have shown an interest in such monitoring. In these instances, data sharing is encouraged. The designated agencies have primary responsibility for BMP monitoring.

Watershed Monitoring
Watershed monitoring measures the success of the implementation measures in accomplishing the overall TMDL goals and includes in-stream monitoring. Monitoring of BMPs measures the success of individual pollutant reduction projects. Implementation plan monitoring will also supplement the watershed information available during development of associated TMDLs and fill data gaps.

In the Upper Owyhee Watershed TMDL, watershed monitoring has the following objectives:

- Evaluate watershed pollutant sources,
- Refine baseline conditions and pollutant loading,
- Evaluate trends in water quality data,
- Evaluate the collective effectiveness of implementation actions in reducing pollutant loading to the mainstem streams and/or tributaries, and
- Gather information and fill data gaps to more accurately determine pollutant loading.

BMP/Project Effectiveness Monitoring
Site or BMP-specific monitoring may be included as part of specific treatment projects if determined appropriate and justified, and will be the responsibility of the designated project manager or grant recipient. The objective of an individual project monitoring plan is to verify that BMPs are properly installed, maintained, and working as designed. Monitoring for pollutant reductions at individual projects typically consists of spot checks, annual reviews, and evaluation of advancement toward reduction goals. The results of these reviews can be used to recommend or discourage similar projects in the future and to identify specific watersheds or reaches that are particularly ripe for improvement.

Evaluation of Efforts over Time
Annual reports on progress toward TMDL implementation will be prepared to provide the basis for assessment and evaluation of progress. Documentation of TMDL implementation activities, actual pollutant reduction effectiveness, and projected load reductions for planned actions will be included. If water quality goals are being met, or if trend analyses show that implementation activities are resulting in benefits that indicate that water quality objectives will be met in a reasonable period of time, then implementation of the plan will continue. If monitoring or analyses show that water quality goals are not being met, the TMDL implementation plan will be revised to include modified objectives and a new strategy for implementation activities.

Implementation Time Frame
The implementation plan must demonstrate a strategy for implementing and maintaining the plan and the resulting water quality improvements over the long term. The timeline should be as specific as possible and should include a schedule for BMP installation and/or evaluation, monitoring schedules, reporting dates, and milestones for evaluating progress. There may be

disparity in timelines for different subwatersheds. This is acceptable as long as there is reasonable assurance that milestones will be achieved.

The implementation plan will be designed to reduce pollutant loads from sources to meet TMDLs, their associated loads, and water quality standards. Idaho DEQ recognizes that where implementation involves significant restoration, water quality standards may not be met for quite some time. In addition, Idaho DEQ recognizes that technology for controlling nonpoint source pollution is, in some cases, in the development stages and will likely take one or more iterations to develop effective techniques.

A definitive timeline for implementing the TMDL and the associated allocations will be developed as part of the implementation plan. This timeline will be developed in consultation with the WAG, the designated agencies, and other interested publics.

5. Total Maximum Daily Load

A TMDL prescribes an upper limit on discharge of a pollutant from all sources so as to assure water quality standards are met. It further allocates this load capacity (LC) among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation (WLA); and nonpoint sources, which receive a load allocation (LA). Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (40 CFR § 130) require a margin of safety (MOS) be a part of the TMDL.

Practically, the MOS is a reduction in the load capacity that is available for allocation to pollutant sources. The natural background load is also effectively a reduction in the load capacity available for allocation to human made pollutant sources. This can be summarized symbolically as the equation: LC = MOS + LA + WLA = TMDL. The equation is written in this order because it represents the logical order in which a loading analysis is conducted. First the load capacity is determined. Then the load capacity is broken down into its components: the necessary MOS is determined and subtracted and then the remainder is allocated among pollutant sources. When the breakdown and allocation is completed we have a TMDL, which must equal the load capacity.

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. Also a required part of the loading analysis is that the load capacity be based on critical conditions – the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both load capacity and pollutant source loads vary, and not necessarily in concert, determination of critical conditions can be more complicated than it may appear on the surface.

A load is fundamentally a quantity of a pollutant discharged over some period of time, and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for "other appropriate measures" to be used when necessary. These "other measures" must still be quantifiable, and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads, and allow "gross allotment" as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads.

The Upper Owyhee Watershed has no point source discharges. All loads are associated with nonpoint sources and the TMDLs will be written for nonpoint sources only. No waste load allocations will be developed.

5.1 Instream Water Quality Targets

The in-stream water quality targets for the water quality limited segments within the Upper Owyhee Watershed TMDL are to provide full support for the designated and existing uses (IDAPA§ 58.01.02.054.02).

Through the Upper Owyhee Watershed SBA it has been determined temperatures are exceeding state of Idaho WQS. Water temperature data showed the criteria for the protection of CWAL and salmonid spawning were exceeded during critical periods. Analysis of biological communities showed sediment was impairing the biota of the stream substrate in Castle Creek, Deep Creek, and Nickel Creek. Turbidity levels in Juniper Basin and Blue Creek Reservoirs exceeded literature values, which the state of Idaho WQS are based on for the protection of CWAL. Both the temperature criteria and the turbidity criteria are set at levels to establish a threshold to maintain or restore existing or designated uses. Table 29 shows the targets to achieve WQS.

Table 29. Water Quality Targets for the Water Quality Limited Segments. Upper Owyhee Watershed.

Pollutants	Water Bodies	Selected Targets
Sediment	Juniper Basin Reservoir Blue Creek Reservoir Deep Creek Castle Creek Nickel Creek	**For Reservoirs:** Turbidity no greater than 25 NTU **For Streams:** TSS no greater than 50 mg/l as a monthly average and no greater than 80 mg/l lasting more than 14 days **Stream Substrate:** Substrate composed of fine sediment of less than 6 mm for no greater than 30% of given area of stream substrate, confined to riffle areas **Stream Bank Erosion Rates:** As defined by load capacity
Temperature	Deep Creek Pole Creek Castle Creek Red Canyon Creek	**Salmonid Spawning:** Water temperatures of 13° C or less with a maximum daily average no greater than 9° C **Cold Water Aquatic Life:** Water temperatures 22° C degrees C or less with a maximum daily average of no greater than 19°C. **Shade Component:** Shade required to meet targets as determined through the use of the SSTEMP[a] model

a Stream Segment Temperature Model (Barthlolow 1999)

Design Conditions

The critical time periods for maintaining cool waters is during the summer months, mainly June through August when warm ambient air temperatures and solar radiation have the greatest impact on water temperature. The general salmonid spawning period is from March 15, through July 15 (Idaho DEQ 2001). Most water temperature data indicate the period from June 1 through July 1 is the critical period for salmonid egg development and fry emergence in the streams in the Upper Owyhee Watershed. Water temperature was predicted through the Stream Segment Temperature Model (SSTEMP) (Bartholow 1999) and the hydrology, or predicted discharge was, determined through the U.S. Geological Survey (USGS) model developed by Hortness and Berenbrock (2001). Through the discharge model, low flows at “Q.80” were determined. This flow of Q.80 represents the predicted flow at 80% of the exceedance of the monthly baseflow. Once the Q.80 was determined, the standard error of estimate was used to determine the lowest possible flow calculated by the model. This low flow was then applied to the SSTEMP model as a means of determining the most critical period for water temperature. Explanation of the models used and validations are located in Appendix D.

Sediment, both suspended and bedload, appears to be critical in a year-round loading analysis. Suspended sediment has impaired CWAL by interfering with the filter feeding capability of macroinvertebrates, while bedload sediment has reduced the amount of available interstitial space of the substrate. This space is required for salmonid spawning (redd construction), fry development, and habitat for macroinvertebrates.

To determine sediment loading, the discharge model developed by Hortness and Berenbrock (2001) was used. Each month's mean discharge was calculated and used for the load analysis.

The major components of nonpoint source management are implementing remedial activity and maintaining that activity. Although the critical periods may be during the summer months, year round management is key to achieve the goals and targets. The response time to changes in management practice will take 20-100 years in some places. The presence and maintenance of good plant vigor, stable streambanks, and stream morphology are important components of the temperature and sediment TMDLs and are required to be maintained during non-critical periods.

Monitoring Points

Monitoring points should follow stations established in the Upper Owyhee Watershed Monitoring Plan (Ingham 2000). However, as land management agencies develop land use plans for each particular land use, monitoring should be conducted to determine BMP effectiveness and compliance with TMDL goals and targets. Since some of the established monitoring points are located on private holdings, permission to enter these sites should be established. Monitoring sites on public lands will be the responsibility of the appropriate land management agency.

Monitoring parameters should include: instream water column TSS (Ralston 1978), stream substrate fine sediment (Burton 1991), flow (Ralston 1978), canopy density (Burton 1991), topographic shading (Burton 1991), stream bank erosion rates (NRCS 1983) and temperature logger placement (Zaroban 2000).

For the two reservoirs, Blue Creek and Juniper Basin, a literature value protecting CWAL of 25 NTUs was chosen as the target. Turbidity monitoring on Mountain View Reservoir on the Shoshone-Paiute Duck Valley Indian Reservation may provide a reference level that could be incorporated into a modification of the TMDL. However, the allocation for turbidity and a MOS will be set. Changes to the TMDL may be made as more information is collected.

Seasonal Variation

The TMDL must account for critical conditions and seasonal variations. In this case, the analysis is based on both critical conditions and seasonal variability, the periods when water temperatures are exceeding state WQS. The two periods include salmonid spawning (spawning and incubation) and CWAL. The temperature analysis was also based on the lowest flow determined by the use of the discharge model (Hortness and Berenbrock 2001), which accounts for the most critical condition. Seasonal variations were also accounted for by analyzing the monitoring data and then focusing on the period of highest temperatures during late spring and early to mid summer.

The TMDL must also account for critical conditions and seasonal variation for sediment delivery. For streams and reservoirs, it is inherently a non-seasonal phenomenon with a disproportionate amount of erosion associated with snowmelt (December through May) and heavy precipitation events, which can occur throughout the year. Sediment delivery is also variable on an annual basis, with erosion rates dependent from year to year on storm events, snow melt duration and winter snowpack. To account for this annual variability, the TMDL and load allocations are expressed as a yearly average. Similarly, the approach used in this TMDL is to identify indicators that are reflective of the net effects from year to year.

5.2 Load Capacity

Capacity, or load capacity is defined as the greatest amount of loading that a water can receive without violating water quality standards (40 CFR §130.2(f)).

Temperature (Heat) Load Capacity

The temperature TMDL will establish a water temperature capacity and reduction requirements based on the numeric criteria in the state Idaho WQS. Target selection is based on a mass/unit/time measurement of joules/meter^2/second (joules/m^2/sec). The SSTEMP model (Bartholow 1999) was utilized to determine the reduction of joules/m^2/sec required to achieve state of Idaho WQS. The SSTEMP model also indicates the amount of shade required to obtain the desired joules/m^2/sec. Thus, the load capacity will use the mass/unit/time measurement and the surrogate measure of percent shading. Appendix D describes the SSTEMP results plus the validation methods used. Table 30 shows the temperature load capacity for the water quality limited segments. Not all segments listed are §303(d) listed segments. However, for the month of June, the SSTEMP model indicated upstream water temperature reductions needs to occur if temperature load capacities are to be met in listed segments.

To address the heat loading capacity, a surrogate measurement of percent shade is utilized. The shading capacity is determined by the amount of joules/meter^2/sec capacity. As the amount of shade increases, the amount of heat exchange to the water body decreases. Table 31 shows predicted percent shade required to achieve WQS on §303(d) listed segments and on those segments not on the §303(d) list.

A simple definition of temperature exchange from hot to cold material is the form of heat. Heat is not defined as the energy itself, but the capability to transfer energy from one source to another based on temperature, hot to cold. The “Le Systeme International d’ Unites” or “SI” for energy is the joule. The joule is the measurement of “work,” “kinetic energy” or “potential energy.” Thus, the use of the term joule(s) within this document is in reference to the exchange of energy from one source to another (Cutnell and Johnson 1989).

A simple relation between heat (energy) and temperature can be seen in the following formula (Cutnell and Johnson 1989):

$$Q = cm\Delta T$$

where Q = Heat (energy)
c = specific heat capacity
m = mass
ΔT = delta temperature (Δ = an increment of a variable)

As temperature changes, the amount of energy or heat, flows from the hotter mass to the colder mass. As an example, a glass of water at room temperature is placed in a refrigerator. Since energy "flows" from hotter to colder, energy from the warmer water flows to the colder air within the refrigerator causing the a loss of energy within the water resulting in colder water. Thus, an overall loss of energy from the water.

Heat exchange between water and the environment can be affected by a variety of factors, including physical and atmospheric attributes. These factors influence the overall heat fluxes (gain or loss) in the water. Figure 16 shows a schematic of how heat fluxes that may affect the transfer of heat in a water body.

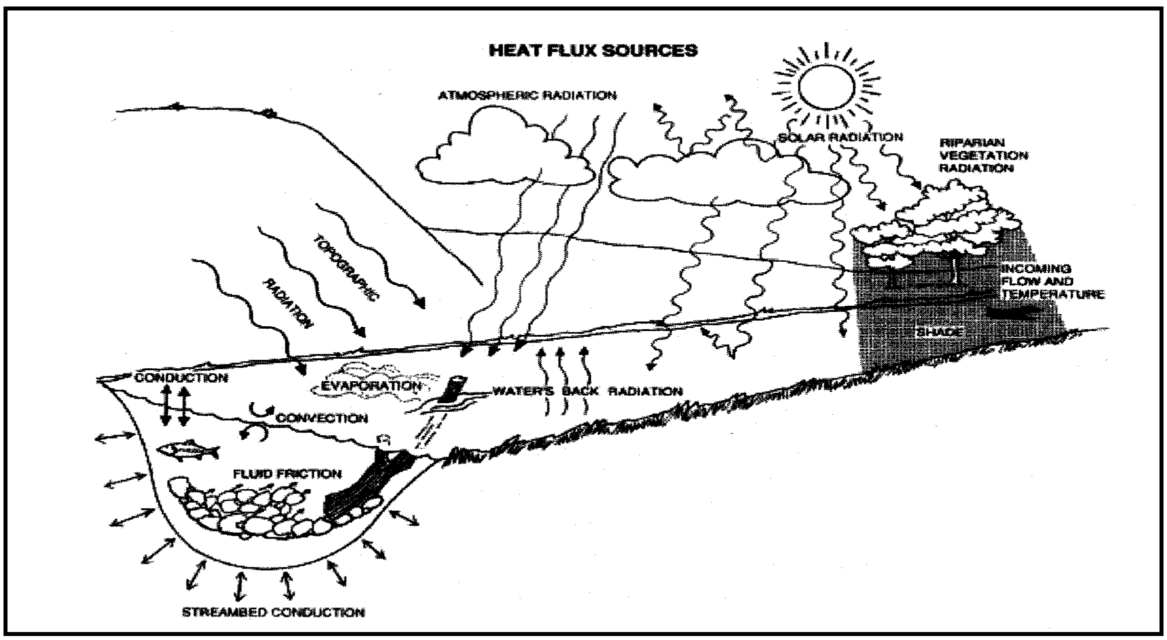


Figure 16. Possible Heat Flux Sources (Re-Printed from Bartholow 1999). Upper Owyhee Watershed.

Table 30 indicates that some load capacity a negative value for joules/m^2/sec. This negative value is an overall sum of the different net mean heat fluxes losses or gains. The mean heat fluxes are governed by a variety of factors including convection, conduction, evaporation, backwater radiation, atmosphere, friction, solar radiation and vegetation component. The SSTEMP model (Bartholow 1999) generates these values based on input from other parameters. A negative value produced by the model indicates that there is a negative heat flux based on the input values entered. In other words, the negative value would indicate there is a greater loss of heat than heat gain (a loss of energy). Thus, temperature would decrease based on the values entered. This provides the required link between heat source and shade.

It should be remembered that the SSTEMP model provides for a gross estimate of heat loss or gains brought on by changing vegetation shade. There are many unknowns to determine what increase vegetation may have on channel width, channel length, air temperature, relative humidity, wind speed or other physical/climatic attributes that will affect water temperature. SSTEMP is only as reliable as the data entered. Thus, as more information is collected, the model can be re-calibrated to reflect certain segment actual conditions.

On Table 31 shading requirements (load capacity) vary from month to month, with the highest percent shade required in June. This higher shade requirement for June is a result of a much lower temperature criteria ($9^{o}C$) that must be met. Thus, a greater amount of solar radiation reduction is required. For July and August the criteria to be met is $22^{o}C$ or less (maximum daily temperature). The SSTEMP model does have limitations for estimating maximum daily temperatures. However, the model does provide a starting point for further evaluations. The model predicted the shade component is not as great as required in June. Both July and August are shown as a comparison. The month of July shows the most stringent level of heat reduction required to achieve criteria of $22^{o}C$ and the support of CWAL.

Table 30. Heat Load Capacity for Cold Water Aquatic Life, Salmonid Spawning and Incubation Periods. Load Capacity Support for Stream Segments. Upper Owyhee Watershed.

Stream[a]	June Load Capacity SS[b] Criteria of 9°C MDAT[c] joules/m²/sec	July Load Capacity CWAL[d] Criteria of 22°C MDT[e] joules/m²/sec	August Load Capacity CWAL Criteria of 22°C MDT joules/m²/sec	Method of Estimated[f]
Upper Deep Creek	5.34	68.46	85.49	SSTEMP
Middle Deep Creek	4.87	55.06	24.16	SSTEMP
Deep Creek below Nickel Creek to Pole Creek	6.47	16.25	148.16	SSTEMP
Lower Deep Creek	0.87	15.88	-52.25	SSTEMP
Upper Pole Creek	37.67	457.31	432.10	SSTEMP
Lower Pole Creek	3.52	46.26	47.76	SSTEMP
Castle Creek	44.06	470.49	468.64	SSTEMP
Red Canyon	40.73	473.40	391.34	SSTEMP
Nickel Creek	58.31	475.02	349.33	SSTEMP
Hurry Back Creek	52.49	481.22	352.87	SSTEMP
Nip and Tuck Creek	75.00	486.22	352.87	SSTEMP
Current Creek	53.18	438.08	356.41	SSTEMP
Camas Creek	32.64	444.84	336.76	SSTEMP
Camel Creek	35.69	448.66	377.48	SSTEMP
Bull Gulch	33.64	450.10	338.86	SSTEMP
Beaver Creek	43.87	467.67	345.16	SSTEMP
Upper Dickshooter Creek	28.39	448.37	339.21	SSTEMP
Lower Dickshooter Creek	82.81	93.40	46.57	SSTEMP

Bold = 1998 ä303(d) Listed Segments,b. salmonid spawning, c. maximum daily avergae temperature, d. cold water aquatic life,e.maximum daily Temperature, f. .Stream Segment Temperature Model (Bartholow 1999)

Table 31. Shade Requirements to Achieve Load Capacity for Stream Segments. Upper Owyhee Watershed.

Stream[a]	June Load Capacity SS[b] Criteria of 9°C MDAT[c] Percent Shade	July Load Capacity CWAL[d] Criteria of 22°C MDT[e] Percent Shade	August Load Capacity CWAL Criteria of 22°C MDT Percent Shade	Method of Estimate[f]
Upper Deep Creek	100	52	59	SSTEMP
Middle Deep Creek	100	57	57	SSTEMP
Lower Deep Creek	100	66	67	SSTEMP
Deep Creek below Nickel Creek to Pole Creek	100	58	57	SSTEMP
Upper Pole Creek	96	96	58	SSTEMP
Lower Pole Creek	100	65	60	SSTEMP
Castle Creek	95	95	58	SSTEMP
Red Canyon Creek	94	94	57	SSTEMP
Nickel Creek	88	88	56	SSTEMP
Hurry Back Creek	92	95	54	SSTEMP
Nip & Tuck Creek	87	87	54	SSTEMP
Current Creek	91	91	53	SSTEMP
Camas Creek	98	98	61	SSTEMP
Camel Creek	97	97	62	SSTEMP
Bull Gulch	98	98	62	SSTEMP
Beaver Creek	97	97	59	SSTEMP
Upper Dickshooter Creek	100	100	62	SSTEMP
Lower Dickshooter Creek	94	65	67	SSTEMP

Bold = 1998 ä303(d) Listed Segments, b. salmonid spawning, c. maximum daily average temperature, d. cold water aquatic life, e.maximum daily temperature, f. .Stream Segment Temperature Model (Bartholow 1999)

Sediment Load Capacity

Idaho utilizes a narrative standard for sediment. The standard states, "Sediment shall not exceed quantities specified in Sections 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in

Section 350" (IDAPA §58.01.02.200.08). The water bodies that have been determined to be impaired by sediment are required to be addressed through the TMDL process, IDAPA §58.01.02.054.02 (Section 2.3 and 2.4). The TMDL process will establish a sediment TMDL based on three criteria; percent fines as related to substrate, water column sediment load and turbidity. The numeric load capacity for these three parameters have been established based on literature review and/or sediment load capacities established in other TMDL developed by the state of Idaho. The load capacity as defined earlier describes the greatest amount of loading that a water can receive without violating water quality standards (40 CFR §130.2(f)).

Water Column Load

The targets set for water column load is based on values obtained from TMDLs developed in watersheds with similar characteristics (e.g. Bruneau River, Idaho DEQ 2000*d*). For the streams that enter into reservoirs, stream sediment load capacity will be based on water column loading at 50 mg/l for a monthly average and/or 80 mg/l not to exceed fourteen days. Table 32 provides load capacity for water bodies that flow into the reservoirs, along with the other water bodies with a TMDL required to address sediment. It should be noted that the water bodies upstream of the reservoirs are not impaired by sediment, but are sources of sediment to the reservoirs.

Table 32. Sediment Load Capacity for Stream Segments. Upper Owyhee Watershed.

Stream	Flows[a] (cfs)	Load Capacity at 50 TSS[b] mg/l (tons/year)	Load Capacity at 80 TSS mg/l (tons/year)	Method of Estimation[c]
Deep Creek	52.0	2555	4088	Flow Concentration
Castle Creek	11.8	579	927	Flow Concentration
Nickel Creek	0.39	19	31	Flow Concentration
Blue Creek above Blue Creek Reservoir	6.74	331	530	Flow Concentration
Juniper Creek above Juniper Basin Reservoir	1.96	96	154	Flow Concentration

Discharge Determined by Hortness and Borenbrook 2001, annual discharge rate, b. Total Suspended Solids, c. Standards Methods 18th Edition

Surrogate Targets

The surrogate targets do not easily fit the mass/unit/time definition as described in 40 CFR 130.2(i). However, description of the current condition of the targets may be appropriate.

Substrate Targets

For sediment, the primary determination a beneficial use is impaired was through the use of biological indicator species, periphyton and macroinvertebrates (Clark 2001 and Bahls 2000 and 2001). A study conducted by Idaho State University (Relyea, Minshall and Danehy 2000) has provided a link between a biological indicator and a physical attribute of stream morphology, stream substrate and percent fines. The Relyea, Minshall and Danehy (2000) study indicated that a threshold of greater than 30% of the substrate of less than 6mm would produce Plecoptera (stoneflys) that are tolerant of sediments. Substrate less than 30% produced species that are more intolerant of sediment. With these biological indicators in mind, and a sediment link that has been developed for the state of Idaho, the targets recommended by Relyea, Minshall and Danehy (2000) is an appropriate surrogate to determine the loading capacity as related to sediment loading. Percent fines substrate targets are presented in Table 33.

Table 33. Percent Fine Load Capacity. Upper Owyhee Watershed.

Stream	Load Capacity 30%[a]
Deep Creek	30%
Nickel Creek	30%
Castle Creek	30%

<6 mm

Turbidity Targets

With the determination CWAL is impaired in both water bodies, a load capacity is required to be established (IDAPA §58.01.02.054.02) (Bahls 2000 and 2001). Most literature values indicate turbidity levels above 25 NTUs impair beneficial uses (Lloyd 1987, Sigler et al. 1984 and Bash, Berman and Bolton 2001). Table 34 shows the load capacity for turbidity.

Table 34. Turbidity Load Capacity for Reservoirs. Upper Owyhee Watershed.

Stream	Load Capacity (NTUs)[a]
Blue Creek Reservoir	25
Juniper Basin Reservoir	25

a. Nephelometric Turbidity Unit

Streambank Targets

The water column targets set for water bodies, either the streams that flow into the reservoirs or the other impaired streams, provide for a link to the pollutant source, streambanks. As demonstrated in Table 32, a mass/unit/time capacity is formulated. With a set annual load capacity in tons/year a surrogate target can be established for streambank erosion, tons/mile/year. This is a linear measurement of streambank stability and a quantity target for streambank erosion rates. The surrogate measurement for streambank load capacity is located in Table 35.

The water column targets set for water bodies, either the streams that flow into the reservoirs or the other impaired streams, provide for a link to the pollutant source, streambanks.

Table 35. Target Stream Bank Load Capacity for Stream Segments. Upper Owyhee Watershed.

Stream	Stream Bank Erosion Rate Load Capacity at 50 mg/l (tons/mile/year)	Method of Estimation[a&b]
Deep Creek	9.7	Flow Concentration, NRCS 1983
Castle Creek	48.3	Flow Concentration, NRCS 1983
Nickel Creek	10.6	Flow Concentration, NRCS 1983
Blue Creek above Blue Creek Reservoir	8.8	Flow Concentration, NRCS 1983
Juniper Creek above Juniper Basin Reservoir	3.8	Flow Concentration, NRCS 1983

a. Standards Methods 18th Edition, b.Natural Resource Conservation Sevice

5.3 Estimates of Existing Pollutant Load

Estimate of Existing Temperature (Heat) Loading

Current loads for temperature are estimated with the use of Hortness and Berenbrock (2001) discharge model and the SSTEMP (Bartholow 1999) temperature model. Regulations allow that loading "…may range from reasonably accurate estimates to gross allotments, depending on the available of data and appropriate techniques for predicting the loading (40 CFR §130.2(I)). The SSTEMP model has been incorporated into previous temperature TMDLs (Washington Department of Ecology 2001). The SSTEMP model has proven to provide adequate gross allotments.

Existing solar radiation and heat transfer are represented in the current load in joules/m^2/second. However, the current load of joules/m^2/second is not totally representative of all reaches where temperature analyses were preformed. Topographic shading estimates were taken from 7.5-minute topographic maps for different segments. In some situations the topographic shade made up 35% of the total shade component. Current vegetation shade was usually placed at zero with the idea that once more information is gathered the implementation of BMPs for that segment can be adjusted. However, even without this high amount of uncertainty, the load capacity will not change.

Azimuth siting is based on the general higher elevation to lower elevation aspect. Most segments have meanders that will change the aspect, but generally these changes in aspect are minor and the overall aspect (usually north to south) was a steady state input for the entire reach. Stream width and depth parameters were set near conditions found throughout the Upper Owyhee Watershed by BURP evaluations. This setting was near a ratio of 25:1. Width-depth ratios were then adjusted to near 12:1 for the final analysis to compensate for future changes in stream morphology caused by increased vegetation and bank stability. It should be pointed out the changes in width-depth ratio without changes to vegetation cover produced some change in the amount of heat transfer and some change in water temperature. An average reduction of less than 0.7 ^{o}C in daily average maximum and minimum temperatures was noted.

Overall the use of the SSTEMP model provided an adequate estimate of the current heat load to segments impaired by temperature. Table 36 shows the estimated existing load.

Table 36. Estimated Existing Heat Load in Stream Segments. Upper Owyhee Watershed.

Stream[a]	Existing Load June joules/m^2/sec	Existing Load July joules/m^2/sec	Existing Load August joules/m^2/sec	Method of Estimation[b]
Upper Deep Creek	20.81	11.36	32.68	SSTEMP
Middle Deep Creek	27.52	51.60	35.21	SSTEMP
Lower Deep Creek	8.37	15.54	-41.42	SSTEMP
Deep Creek below Nickel Creek to Pole Creek	25.56	27.54	35.21	SSTEMP
Upper Pole Creek	241.66	566.77	432.10	SSTEMP
Lower Pole Creek	5.62	52.46	-0.83	SSTEMP
Castle Creek	274.04	607.76	468.64	SSTEMP
Red Canyon	191.21	523.71	391.34	SSTEMP
Nickel Creek	190.91	520.37	390.37	SSTEMP
Hurry Back Creek	246.21	571.11	446.76	SSTEMP
Nip & Tuck Creek	242.46	568.79	429.09	SSTEMP
Current Creek	191.91	523.40	391.09	SSTEMP
Camas Creek	260.69	588.57	442.25	SSTEMP
Camel Creek	235.30	567.07	428.34	SSTEMP
Bull Gulch	191.66	569.56	448.17	SSTEMP
Beaver Creek	273.29	607.14	468.07	SSTEMP
Upper Dickshooter Creek	274.12	591.40	468.46	SSTEMP
Lower Dickshooter Creek	83.39	112.68	28.26	SSTEMP

a. 1998 ä303(d) Listed Segments, b. Stream Segment Temperature Model (Bartholow, 1999)

Estimate of Existing Sediment Loading

Water Column Loading

Estimating sediment loads in the Upper Owyhee has proven more difficult. Little to no data and with limited access too many segments have compounded the difficulties in estimating existing loading. The use of the USGS annual streamflow model (Hortness and Berenbrock 2001) does provide a gross estimate of flows that may be found in streams and rivers in the Upper Owyhee Watershed. With available flow estimates, load capacity targets can be made based on expected sediment concentration recommendations. The values of 80 mg/l and 50 mg/l represent in-stream water quality targets that have been incorporated into other sediment TMDLs in the state of Idaho (e.g., Lower Boise River TMDL and Bruneau River TMDL). It is believed the use of these concentration levels provides an adequate estimate to protect existing uses in the Upper Owyhee Watershed.

However, to establish a current sediment load based on in-stream water column loads is impossible. Data is available to provide a gross estimate based on streambank erosion found in the Succor Creek watershed and provided by a study completed for a TMDL for that watershed (HUC 17050103). Horsburgh (2002) found current streambank erosion rates in the watershed were between 13 to 215 tons/mile/year. Table 37 shows the gross estimates of possible in-water column sediment concentrations for those streams required to have a sediment load allocation. These concentrations are based on low and high yield estimates from stream bank erosion rates of 13 to 214 tons/mile/year.

Table 37. Estimated In-Stream Concentrations based on Streambank Erosion. Upper Owyhee Watershed.

Stream	Miles of 2nd and Larger Order Streams	Estimated Flow[a] cfs	Estimated Concentration Low Yield at 13 tons/mile/year (mg/l)	Estimated Concentration High Yield at 214 tons/mile/year (mg/l)	Method of Estimation
Deep Creek	262.6	52.0	67	1098	Based on probable bank erosion yields of 13-214 tons/mile/year
Castle Creek	12.0	11.8	13	218	Based on probable bank erosion yields of 13-214 tons/mile/year
Nickel Creek	1.8	0.4	59.7	983	Based on probable bank erosion yields of 13-214 tons/mile/year
Blue Creek above Blue Creek Reservoir	37.7	6.7	49.4	814	Based on probable bank erosion yields of 13-214 tons/mile/year
Juniper Creek above Juniper Basin Reservoir	25.0	2.0	250	4114	Based on probable bank erosion yields of 13-214 tons/mile/year

a Flow from Hortness and Borenbrook (2001)

The data presented in Table 37 does not accurately show the actual loading and many assumptions would have to occur. Mainly, erosion rates would be equal throughout the 2nd order water bodies for any given stream. Secondly, the flow rates used to calculate the estimated sediment concentrations are an annual discharge rate. Discharge rates can vary greatly depending on a variety of factors such as storm events, snow melt, drought conditions and other meteorological and physical conditions. However, the data presented does show the wide variability of sediment load that could be encountered through streambank erosion.

The data in Table 37 does not represent possible sediment load from overland sources and would only represent streambank sources. Overland soil erosion rates have been determined using the modified universal soil loss equation as prepared by the BLM during the development of the RMP (Seronko 2002). This study provided some computed values for expected soil erosion rates in the Upper Owyhee Watershed. However, the general overall soil loss is broken down for an entire watershed and does not take into account different landforms such as stream channels. Also, the erosion rate determined by the ORMP only indicates soil movement and not delivery rates to surface waters. As noted in Table 38, overland soil erosion in the Upper Owyhee Watershed could exceed the load capacity by 30 to 790 times for both the 50 mg/l and 80 mg/l targets.

In the Upper Owyhee Watershed it is expected that streambank erosion is the largest contributor to surface water sediment loads. As more stream bank information and more accurate overland erosion delivery rates are collected by land management agencies, the value presented in Tables 37 and 38 will be adjusted.

Table 38. Estimated Overland Erosion. Upper Owyhee Watershed.

Stream	Watershed Total Size (acres)	Estimated High Yield at 2.4 tons/year (tons/year)	Estimated Low Yield at 1.1 tons/year (tons/year)	Method of Estimation
Deep Creek	275,563	661,351	303,119	MUSLE, Seronko, 2002
Castle Creek	15,372	36,893	16,909	MUSLE, Seronko, 2002
Nickel Creek	2,070	4,968	2,277	MUSLE, Seronko, 2002
Blue Creek above Blue Creek Reservoir	39,224	94,138	58,356	MUSLE, Seronko, 2002
Juniper Creek above Juniper Basin Reservoir	53,051	127,322	43,146	MUSLE, Seronko, 2002

a Modified Universal Soil Loss Equation

Surrogate Targets

The surrogate targets do not easily fit the mass/unit/time definition as described in 40 CFR 130.2(i). However, description of the current condition of the targets may be appropriate.

Substrate

Data collected from the various BURP monitoring sites along with the various monitoring dates indicated that stream substrate percent fines (<6mm) varied from 15% to 55%. Most of the sites that had SMI scores that indicated the streams were not fully supporting CWAL had percent fines (<6mm) greater than 30%. More information will be required to determine the site potential for different segments that will have a stream substrate target established.

Turbidity

Turbidity levels collected in 2001 showed a level of 65 NTUs for Blue Creek Reservoir and 70 NTUs for Juniper Basin Reservoir. The estimate for the possible existing loading from upstream sources is described in Tables 37 and 38.

5.4 Allocation

All pollution sources are from nonpoint or natural sources. Allocations will be based on land use, which in the majority of the Upper Owyhee Watershed consists of rangeland. For sediment allocations riparian areas have been calculated, but represent a small portion of the land use in the sub-watersheds. Forested areas within the watershed do not contain harvestable types of timber. Thus, forest practices are not an issue and those areas identified as forested are incorporated into the primary land use of rangeland. This designation would only effect the sediment allocation in the Deep Creek and Castle Creek subbasins where forested land use makes up approximately 28% and 32% respectively. Juniper Basin and Blue Creek do not contain any forested areas. As with sediment, allocations for temperature reductions will be based on the single land use of rangeland.

Margin of Safety

The Clean Water Act and its regulations require a MOS to address uncertainty in the TMDL. For temperature, certain amounts of conservative assumption are built into the TMDL to apply an implicit MOS. For the temperature TMDL, conservative assumptions concerning physical attributes other than increased shade were made that may account for uncertainties in the model analysis that provide for a MOS:

Temperature

Enhancement of streambank vegetation will promote bank stability creating better properly functioning stream morphology. This will increase ground water supply and the hyporheic flow conditions with a reduction in water temperature. These effects were not accounted for in the temperature analysis.

The SSTEMP model has limitations for streams that may be gaining or losing reaches. Reaches that gain through groundwater recharge offer cold water refugia for CWAL. These effects were not accounted in the temperature analysis.

The reestablishment of access to a floodplain will enhance stream morphology. With the potential to develop a flood plain, stream conditions will allow for more sinuosity, decreased width-depth ratio and higher frequency of pools, which offer cooler refuge areas for CWAL. These effects were not accounted in the temperature analysis.

Reduced sediments can be expected to increase pool depth and pool frequency. This increase will also provide offer cooler refuge areas for CWAL. These effects were not accounted in the temperature analysis.

The flow model utilized determines flows at the most critical low flow periods. Along with the critical flow conditions that may be encountered, the critical condition analysis and model validation followed data collected during two years of drought conditions.. With increased available water in "normal" water years increased flows and lower water temperature can be expected than those observed in 2000 and 2001. These effects were not accounted in the temperature analysis.

Sediment

For sediment, some uncertainty and unknowns are present that would demonstrate a MOS is required. Some of these uncertainties include the lack of knowledge on the amount of sediment that is delivered to water bodies from upland sources, lack of data to demonstrate the existing load and what would constitute a natural loading. Another major unknown is the particular reach's streambank erosion rates, both induced and natural. Some reaches, especially in Deep Creek, may have erosion rates well below the target due to geology and stream morphology.

With these uncertainties, it is proposed that an explicit MOS of (10%) of the load capacity be applied to the sediment load allocation. The Bruneau River TMDL (Idaho DEQ 2000) established a similar MOS allocation. The MOS will be an allocation that can not be expected to be reduced, but as an allocation to the uncertainty of the total allocation to meet the load capacity. As more information is collected by land management agencies, the MOS may be adjusted to reflect the natural condition.

Remaining Available Load

The remaining load is the load allocation (LA). This load is to be allocated to the human induced nonpoint source pollutants. This component of the load capacity for the load allocation can be calculated by the following formula:

$$LC = MOS + WLA + LA + WLA = TMDL$$

Since there is no point source for the waste load allocation, the following formula is used to calculate the load allocation:

$$LC = LA + MOS = TMDL$$

For temperature there is an implicit MOS, therefore the MOS for temperature is zero. For sediment the MOS will be applied at 10% of the load capacity. Therefore the following formulas will be applied for temperature and sediment;

For temperature:

$$LA = LC = TMDL$$

For Sediment:

$$LA = LC - 10\% \text{ of } LC = TMDL$$

Temperature Load Allocations and Targets

For temperature, the entire load allocation is assigned to the current primary land use, rangeland. As defined in 40 CFR 130.2(i), the load allocation will be based in mass/per/unit/time. Table 39 shows the LA calculations in joules/m^2/sec for the temperature portion of the TMDL. However, the SSTEMP model provided surrogate targets that may be more useful for land management agencies and a more appropriate for site potential application. These targets are located in Table 40. Since the targets for water body shading are more stringent for June, this will be the target that will have to be met.

Table 39. June, July and August Load Allocation for Temperature. Upper Owyhee Watershed.

Stream[a]	Land Use	June Load Allocation SS[b] Criteria of 9°C MDAT[c] joules/m²/sec	July Load Allocation CWAL[d] Criteria of 22°C MDT[e] joules/m²/sec	August Load Allocation CWAL Criteria of 22°C MDT joules/m²/sec	Method of Estimate[f]
Upper Deep Creek	Rangeland	5.34	68.46	85.49	SSTEMP
Middle Deep Creek	Rangeland	4.87	55.06	24.16	SSTEMP
Deep Creek below Nickel Creek to Pole Creek	Rangeland	6.47	16.25	148.16	SSTEMP
Lower Deep Creek	Rangeland	0.87	15.88	-52.25	SSTEMP
Upper Pole Creek	Rangeland	37.67	457.31	432.10	SSTEMP
Lower Pole Creek	Rangeland	3.52	46.26	47.76	SSTEMP
Castle Creek	Rangeland	44.06	470.49	468.64	SSTEMP
Red Canyon	Rangeland	40.73	473.40	391.34	SSTEMP
Nickel Creek	Rangeland	58.31	475.02	349.33	SSTEMP
Hurry Back Creek	Rangeland	52.49	481.22	352.87	SSTEMP
Nip and Tuck Creek	Rangeland	75.00	486.22	352.87	SSTEMP
Current Creek	Rangeland	53.18	438.08	356.41	SSTEMP
Camas Creek	Rangeland	32.64	444.84	336.76	SSTEMP
Camel Creek	Rangeland	35.69	448.66	377.48	SSTEMP
Bull Gulch	Rangeland	33.64	450.10	338.86	SSTEMP
Beaver Creek	Rangeland	43.87	467.67	345.16	SSTEMP
Upper Dickshooter Creek	Rangeland	28.39	448.37	339.21	SSTEMP
Lower Dickshooter Creek	Rangeland	82.81	93.40	46.57	SSTEMP

Bold = 1998 ä303(d) Listed Segments, b. salmonid spawning, c. Maximum Dauly Average Temperature, d.cold water aquatic life, e.Maximum Daily Temperature

Steam Segment Temperature Model (Bartholow 1999)

Table 40. Shade Requirements to Achieve Load Capacity for Stream Segments. Upper Owyhee Watershed.

Stream[a]	Land Use	June Load Allocations SS[b] Criteria Of 9°C MDAT[c] Percent Shade	July Load Allocations CWAL[d] Criteria of 22°C MDT[e] Percent Shade	August Load Allocations CWAL Criteria of 22°C MDT Percent Shade	Method of Estimate[f]
Upper Deep Creek	Rangeland	100	52	59	SSTEMP
Middle Deep Creek	Rangeland	100	57	57	SSTEMP
Lower Deep Creek	Rangeland	100	66	67	SSTEMP
Deep Creek below Nickel Creek to Pole Creek	Rangeland	100	58	57	SSTEMP
Upper Pole Creek	Rangeland	96	96	58	SSTEMP
Lower Pole Creek	Rangeland	100	65	60	SSTEMP
Castle Creek	Rangeland	95	95	58	SSTEMP
Red Canyon Creek	Rangeland	94	94	57	SSTEMP
Nickel Creek	Rangeland	88	88	56	SSTEMP
Hurry Back Creek	Rangeland	92	95	54	SSTEMP
Nip & Tuck Creek	Rangeland	87	87	54	SSTEMP
Current Creek	Rangeland	91	91	53	SSTEMP
Camas Creek	Rangeland	98	98	61	SSTEMP
Camel Creek	Rangeland	97	97	62	SSTEMP
Bull Gulch	Rangeland	98	98	62	SSTEMP
Beaver Creek	Rangeland	97	97	59	SSTEMP
Upper Dickshooter Creek	Rangeland	100	100	62	SSTEMP
Lower Dickshooter Creek	Rangeland	94	65	67	SSTEMP

a. Bold = 1998 ä303(d) Listed Segments, b. salmonid spawning, c. maximum daily average temperature, d. cold water aquatic life, e.maximum daily temperature

f. .Stream Segment Temperature Model (Bartholow 1999)

Sediment Load Allocations and Targets

For sediment, the entire load allocation is assigned to the current primary land use, rangeland. Tables 41 and 42 show the load allocation calculations in tons/year for the sediment portion of the TMDL. Table 43 shows the turbidity targets to achieve load allocation for the reservoirs. Tables 44 shows the required percent fines targets to achieve load allocation. Table 45 shows the required streambank erosion rate targets to achieve the load allocation.

Table 41. Sediment Load Allocation for a target of 50 mg/l. Upper Owyhee Watershed.

Stream	Land Use	Load Capacity tons/year	MOS[a] tons/year	Load Allocation tons/year
Deep Creek	Rangeland	2,555	255.5	2299.5
Castle Creek	Rangeland	579	57.9	521.1
Nickel Creek	Rangeland	19	1.9	17.1
Upper Blue Creek Basin	Rangeland	331	33.1	297.9
Upper Juniper Basin	Rangeland	96	9.6	86.4

a. Margin of Safety

Table 42. Sediment Load Allocation for a target of 80 mg/l. Upper Owyhee Watershed.

Stream	Land Use	Load Capacity tons/year	MOS[a] tons/year	Load Allocation tons/year
Deep Creek	Rangeland	4088	408.8	3679.2
Castle Creek	Rangeland	927	92.7	834.3
Nickel Creek	Rangeland	31	3.1	27.9
Upper Blue Creek Basin	Rangeland	530	53.0	477.0
Upper Juniper Basin	Rangeland	154	15.4	138.6

a. Margin of Safety

Table 43. Turbidity Load Allocations at 25 NTUs. Upper Owyhee Watershed.

Stream	Land Use	Load Capacity (NTUs)[a]	MOS[b] (NTUs)	Load Allocation (NTUs)
Blue Creek Reservoir	Rangeland	25	2.5	22.5
Juniper Basin Reservoir	Rangeland	25	2.5	22.5

a. Nephelometric Turbidity Unit, b. Margin of Safety

Table 44. Percent Fine Allocations. Upper Owyhee Watershed.

Stream	Land Use	Load Capacity 30%[a]	MOS[b] at 30% Load Capacity	Load Allocation
Deep Creek	Rangeland	30%	3%	27%
Nickel Creek	Rangeland	30%	3%	27%
Castle Creek	Rangeland	30%	3%	27%

a. >6 mm b. Margin of Safety

Table 45. Streambank Erosion Rates. Upper Owyhee Watershed.

Stream	Land Use	Load Capacity tons/mile/year	MOS[b] tons/mile/year	Load Allocation tons/mile/year
Deep Creek	Rangeland	9.7	1.0	8.7
Castle Creek	Rangeland	48.3	4.8	43.5
Nickel Creek	Rangeland	10.6	1.0	9.6
Upper Blue Creek Basin	Rangeland	8.8	0.9	7.9
Upper Juniper Basin	Rangeland	3.8	0.4	3.4

a. Margin of Safety

5.5 Conclusion

The above tables describe the required load allocation to address both temperature and sediment issues in the Upper Owyhee Watershed. All allocations are gross estimates with the belief that once more data is collected by the appropriate land management agencies, and other interested parties, refinements to these allocations can be made.

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GIS Coverages:

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Upper Owyhee Watershed

Subbasin Assessment and

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Technical Appendices

January 2003

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Glossary

305(b)	Refers to section 305 subsection "b" of the Clean Water Act. 305(b) generally describes a report of each state's water quality, and is the principle means by which the U.S. Environmental Protection Agency, congress, and the public evaluate whether U.S. waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.
303(d)	Refers to section 303 subsection "d" of the Clean Water Act. 303(d) requires states to develop a list of water bodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to U.S. Environmental Protection Agency approval.
Acre-Foot	A volume of water that would cover an acre to a depth of one foot. Often used to quantify reservoir storage and the annual discharge of large rivers.
Adsorption	The adhesion of one substance to the surface of another. Clays, for example, can adsorb phosphorus and organic molecules.
Aeration	A process by which water becomes charged with air directly from the atmosphere. Dissolved gases, such as oxygen, are then available for reactions in water.
Aerobic	Describes life, processes, or conditions that require the presence of oxygen.
Assessment Database (ADB)	The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of water bodies, and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.
Adfluvial	Describes fish whose life history involves seasonal migration from lakes to streams for spawning.

Adjunct In the context of water quality, adjunct refers to areas directly adjacent to focal or refuge habitats that have been degraded by human or natural disturbances and do not presently support high diversity or abundance of native species.

Alevin A newly hatched, incompletely developed fish (usually a salmonid) still in nest or inactive on the bottom of a water body, living off stored yolk.

Algae Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.

Alluvium Unconsolidated recent stream deposition.

Ambient General conditions in the environment. In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations, or specific disturbances such as a wastewater outfall (Armantrout 1998, EPA 1996).

Anadromous Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the salt water but return to fresh water to spawn.

Anaerobic Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.

Anoxia The condition of oxygen absence or deficiency.

Anthropogenic Relating to, or resulting from, the influence of human beings on nature.

Anti-Degradation Refers to the U.S. Environmental Protection Agency's interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.56).

Aquatic	Occurring, growing, or living in water.
Aquifer	An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.
Assemblage (aquatic)	An association of interacting populations of organisms in a given water body; for example, a fish assemblage, or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).
Assimilative Capacity	The ability to process or dissipate pollutants without ill effect to beneficial uses.
Autotrophic	An organism is considered autotrophic if it uses carbon dioxide as its main source of carbon. This most commonly happens through photosynthesis.
Batholith	A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.
Bedload	Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.
Beneficial Use	Any of the various uses of water, including, but not limited to, aquatic biota, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.
Beneficial Use Reconnaissance Program (BURP)	A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers.
Benthic	Pertaining to or living on or in the bottom sediment of a water body.
Benthic Organic Matter	The organic matter on the bottom of a water body.
Benthos	Organisms living in and on the bottom sediment of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the lake and stream bottoms.

Best Management Practices (BMPs)	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.
Best Professional Judgment	A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.
Biochemical Oxygen Demand (BOD)	The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.
Biological Integrity	1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).
Biomass	The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.
Biota	The animal and plant life of a given region.
Biotic	A term applied to the living components of an area.
Clean Water Act (CWA)	The Federal Water Pollution Control Act (Public Law 92-50, commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987 (Public Law 100-4), establishes a process for states to use to develop information on, and control the quality of, the nation's water resources.
Coliform Bacteria	A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria).
Colluvium	Material transported to a site by gravity.
Community	A group of interacting organisms living together in a given place.

Conductivity	The ability of an aqueous solution to carry electric current, expressed in micro (ì) mhos/cm at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.
Cretaceous	The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.
Criteria	In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. EPA develops criteria guidance; states establish criteria.
Cubic Feet per Second	A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.
Cultural Eutrophication	The process of eutrophication that has been accelerated by human-caused influences. Usually seen as an increase in nutrient loading (also see Eutrophication).
Culturally Induced Erosion	Erosion caused by increased runoff or wind action due to the work of humans in deforestation, cultivation of the land, overgrazing, and disturbance of natural drainages; the excess of erosion over the normal for an area (also see Erosion).
Debris Torrent	The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.
Decomposition	The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.
Depth Fines	Percent by weight of particles of small size within a vertical core of volume of a streambed or lake bottom sediment. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 6.5 mm depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 cm).
Designated Uses	Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.

Discharge	The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).
Dissolved Oxygen (DO)	The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.
Disturbance	Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.
E. coli	Short for *Escherichia Coli*, *E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans. Their presence is often indicative of fecal contamination.
Ecology	The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.
Ecological Indicator	A characteristic of an ecosystem that is related to, or derived from, a measure of a biotic or abiotic variable that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability. Ecological indicators are often used within the multimetric index framework.
Ecological Integrity	The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes (EPA 1996).
Ecosystem	The interacting system of a biological community and its non-living (abiotic) environmental surroundings.
Effluent	A discharge of untreated, partially treated, or treated wastewater into a receiving water body.

Endangered Species Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.

Environment The complete range of external conditions, physical and biological, that affect a particular organism or community.

Eocene An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.

Eolian Windblown, referring to the process of erosion, transport, and deposition of material by the wind.

Ephemeral Stream A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long continued supply from melting snow or other sources. Its channel is at all times above the water table. (American Geologic Institute 1962).

Erosion The wearing away of areas of the earth's surface by water, wind, ice, and other forces.

Eutrophic From Greek for "well nourished," this describes a highly productive body of water in which nutrients do not limit algal growth. It is typified by high algal densities and low clarity.

Eutrophication 1) Natural process of maturing (aging) in a body of water. 2) The natural and human-influenced process of enrichment with nutrients, especially nitrogen and phosphorus, leading to an increased production of organic matter.

Exceedence A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.

Existing Beneficial Use or Existing Use A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02).

Exotic Species A species that is not native (indigenous) to a region.

Extrapolation Estimation of unknown values by extending or projecting from known values.

Fauna	Animal life, especially the animals characteristic of a region, period, or special environment.
Fecal Coliform Bacteria	Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by bacteria (also see Coliform Bacteria).
Fecal Streptococci	A species of spherical bacteria including pathogenic strains found in the intestines of warm-blooded animals.
Feedback Loop	In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.
Fixed-Location Monitoring	Sampling or measuring environmental conditions continuously or repeatedly at the same location.
Flow	See Discharge.
Fluvial	In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.
Focal	Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.
Fully Supporting	In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2000).
Fully Supporting Cold Water	Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions (EPA 1997).
Fully Supporting but Threatened	An intermediate assessment category describing water bodies that fully support beneficial uses, but have a declining trend in water quality conditions, which if not addressed, will lead to a "not fully supporting" status.
Geographical Information Systems (GIS)	A georeferenced database.

Geometric Mean	A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.
Grab Sample	A single sample collected at a particular time and place. It may represent the composition of the water in that water column.
Gradient	The slope of the land, water, or streambed surface.
Ground Water	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as stream flow.
Growth Rate	A measure of how quickly something living will develop and grow, such as the amount of new plant or animal tissue produced per a given unit of time, or number of individuals added to a population.
Habitat	The living place of an organism or community.
Headwater	The origin or beginning of a stream.
Hydrologic Basin	The area of land drained by a river system, a reach of a river and its tributaries in that reach, a closed basin, or a group of streams forming a drainage area (also see Watershed).
Hydrologic Cycle	The cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Atmospheric moisture, clouds, rainfall, runoff, surface water, ground water, and water infiltrated in soils are all part of the hydrologic cycle.
Hydrologic Unit	One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described four levels (region, subregion, accounting unit, cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, fourth field hydrologic units have been more commonly called subbasins. Fifth and sixth field hydrologic units have since been delineated for much of the country and are known as watershed and subwatersheds, respectively.

Hydrologic Unit Code (HUC)	The number assigned to a hydrologic unit. Often used to refer to fourth field hydrologic units.
Hydrology	The science dealing with the properties, distribution, and circulation of water.
Impervious	Describes a surface, such as pavement, that water cannot penetrate.
Influent	A tributary stream.
Inorganic	Materials not derived from biological sources.
Instantaneous	A condition or measurement at a moment (instant) in time.
Intergravel Dissolved Oxygen	The concentration of dissolved oxygen within spawning gravel. Consideration for determining spawning gravel includes species, water depth, velocity, and substrate.
Intermittent Stream	1) A stream that flows only part of the year, such as when the ground water table is high or when the stream receives water from springs or from surface sources such as melting snow in mountainous areas. The stream ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. 2) A stream that has a period of zero flow for at least one week during most years.
Interstate Waters	Waters that flow across or form part of state or international boundaries, including boundaries with Indian nations.
Irrigation Return Flow	Surface (and subsurface) water that leaves a field following the application of irrigation water and eventually flows into streams.
Key Watershed	A watershed that has been designated in Idaho Governor Batt's *State of Idaho Bull Trout Conservation Plan* (1996) as critical to the long-term persistence of regionally important trout populations.
Knickpoint	Any interruption or break of slope.
Land Application	A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.

Limiting Factor A chemical or physical condition that determines the growth potential of an organism. This can result in a complete inhibition of growth, but typically results in less than maximum growth rates.

Limnology The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.

Load Allocation (LA) A portion of a water body's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).

Load(ing) The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.

Loading Capacity (load capacity) A determination of how much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.

Loam Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.

Loess A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodable.

Lotic An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.

Luxury Consumption A phenomenon in which sufficient nutrients are available in either the sediment or the water column of a water body, such that aquatic plants take up and store an abundance in excess of the plants' current needs.

Macroinvertebrate An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500ìm mesh (U.S. #30) screen.

Macrophytes Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum sp.*), are free-floating forms not rooted in sediment.

Margin of Safety (MOS)	An implicit or explicit portion of a water body's loading capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.
Mass Wasting	A general term for the down slope movement of soil and rock material under the direct influence of gravity.
Mean	Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.
Median	The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; and 6 is the median of 1, 2, 5, 7, 9, 11.
Metric	1) A discrete measure of something, such as an ecological indicator (e.g., number of distinct taxon). 2) The metric system of measurement.
Milligrams per Liter (mg/l)	A unit of measure for concentration in water, essentially equivalent to parts per million (ppm).
Million gallons per day (MGD)	A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.
Miocene	Of, relating to, or being an epoch of, the Tertiary between the Pliocene and the Oligocene periods, or the corresponding system of rocks.
Monitoring	A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a water body.
Mouth	The location where flowing water enters into a larger water body.

National Pollution Discharge Elimination System (NPDES)	A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.
Natural Condition	A condition indistinguishable from that without human-caused disruptions.
Nitrogen	An element essential to plant growth, and thus is considered a nutrient.
Nodal	Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.
Nonpoint Source	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
Not Assessed (NA)	A concept and an assessment category describing water bodies that have been studied, but are missing critical information needed to complete an assessment.
Not Attainable	A concept and an assessment category describing water bodies that demonstrate characteristics that make it unlikely that a beneficial use can be attained (e.g., a stream that is dry but designated for salmonid spawning).
Not Fully Supporting	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2000).
Not Fully Supporting Cold Water	At least one biological assemblage has been significantly modified beyond the natural range of its reference condition (EPA 1997).
Nuisance	Anything which is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.

Nutrient	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.
Nutrient Cycling	The flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).
Oligotrophic	The Greek term for "poorly nourished." This describes a body of water in which productivity is low and nutrients are limiting to algal growth, as typified by low algal density and high clarity.
Organic Matter	Compounds manufactured by plants and animals that contain principally carbon.
Orthophosphate	A form of soluble inorganic phosphorus most readily used for algal growth.
Oxygen-Demanding Materials	Those materials, mainly organic matter, in a water body which consume oxygen during decomposition.
Parameter	A variable, measurable property whose value is a determinant of the characteristics of a system; e.g., temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.
Partitioning	The sharing of limited resources by different races or species; use of different parts of the habitat, or the same habitat at different times. Also the separation of a chemical into two or more phases, such as partitioning of phosphorus between the water column and sediment.
Bacteria	Disease-producing organisms (e.g., bacteria, viruses, parasites).
Perennial Stream	A stream that flows year-around in most years.
Periphyton	Attached microflora (algae and diatoms) growing on the bottom of a water body or on submerged substrates, including larger plants.

Pesticide	Substances or mixtures of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.
pH	The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.
Phased TMDL	A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a water body. Under a phased TMDL, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.
Phosphorus	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
Physiochemical	In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the terms “physical/chemical” and “physicochemical.”
Plankton	Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.
Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable “point” of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
Pollutant	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.

Pollution	A very broad concept that encompasses human-caused changes in the environment which alter the functioning of natural processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.
Population	A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.
Pretreatment	The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.
Primary Productivity	The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.
Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
Quality Assurance (QA)	A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training. The goal of QA is to assure the data provided are of the quality needed and claimed (Rand 1995, EPA 1996).
Quality Control (QC)	Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples. QC is implemented at the field or bench level (Rand 1995, EPA 1996).
Quantitative	Descriptive of size, magnitude, or degree.
Reach	A stream section with fairly homogenous physical characteristics.
Reconnaissance	An exploratory or preliminary survey of an area.
Reference	A physical or chemical quantity whose value is known, and thus is used to calibrate or standardize instruments.

Reference Condition	1) A condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).
Reference Site	A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.
Representative Sample	A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.
Resident	A term that describes fish that do not migrate.
Respiration	A process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process converts organic matter to energy, carbon dioxide, water, and lesser constituents.
Riffle	A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.
Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.
Riparian Habitat Conservation Area (RHCA)	A U.S. Forest Service description of land within the following number of feet up-slope of each of the banks of streams: - 300 feet from perennial fish-bearing streams - 150 feet from perennial non-fish-bearing streams - 100 feet from intermittent streams, wetlands, and ponds in priority watersheds.
River	A large, natural, or human-modified stream that flows in a defined course or channel, or a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.

Sediment	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
Settleable Solids	The volume of material that settles out of one liter of water in one hour.
Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stagnation	The absence of mixing in a water body.
Stenothermal	Unable to tolerate a wide temperature range.
Stratification	An Idaho Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.
Storm Water Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
Stressors	Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.
Subbasin	A large watershed of several hundred thousand acres. This is the name commonly given to 4th field hydrologic units (also see Hydrologic Unit).
Subbasin Assessment	A watershed-based problem assessment that is the first step in

(SBA) developing a total maximum daily load in Idaho.

Subwatershed A smaller watershed area delineated within a larger watershed, often for purposes of describing and managing localized conditions. Also proposed for adoption as the formal name for 6th field hydrologic units.

Surface Fines Sediment of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 mm depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.

Surface Runoff Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.

Surface Water All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.

Suspended Sediment Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediment cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.

Taxon Any formal taxonomic unit or category of organisms (e.g., species, genus, family, order). The plural of taxon is taxa (Armantrout 1998).

Tertiary An interval of geologic time lasting from 66.4 to 1.6 million years ago. It constitutes the first of two periods of the Cenozoic Era, the second being the Quaternary. The Tertiary has five subdivisions, which from oldest to youngest are the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs.

Thalweg The center of a stream's current, where most of the water flows.

Threatened Species Species, determined by the U.S. Fish and Wildlife Service, which are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

Total Maximum Daily Load (TMDL)	A TMDL is a water body's loading capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. TMDL = Loading Capacity = Load Allocation + Wasteload Allocation + Margin of Safety. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.
Total Dissolved Solids	Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.
Total Suspended Solids (TSS)	The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Greenborg, Clescevi, and Eaton 1995) call for using a filter of 2.0 micron or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.
Toxic Pollutants	Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.
Tributary	A stream feeding into a larger stream or lake.
Trophic State	The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.
Turbidity	A measure of the extent to which light passing through water is scattered by fine suspended materials. The effect of turbidity depends on the size of the particles (the finer the particles, the greater the effect per unit weight) and the color of the particles.
Vadose Zone	The unsaturated region from the soil surface to the ground water table.
Wasteload Allocation (WLA)	The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.

Water Body	A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.
Water Column	Water between the interface with the air at the surface and the interface with the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.
Water Pollution	Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental, or injurious to public health, safety, or welfare; to fish and wildlife; or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.
Water Quality	A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.
Water Quality Criteria	Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.
Water Quality Limited	A label that describes water bodies for which one or more water quality criterion is not met or beneficial uses are not fully supported. Water quality limited segments may or may not be on a 303(d) list.
Water Quality Limited Segment (WQLS)	Any segment placed on a state's 303(d) list for failure to meet applicable water quality standards, and/or is not expected to meet applicable water quality standards in the period prior to the next list. These segments are also referred to as "303(d) listed."
Water Quality Management Plan	A state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.
Water Quality Modeling	The prediction of the response of some characteristics of lake or stream water based on mathematical relations of input variables such as climate, stream flow, and inflow water quality.

Water Quality Standards	State-adopted and EPA-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.
Water Table	The upper surface of ground water; below this point, the soil is saturated with water.
Watershed	1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region which contributes water to a point of interest in a water body.
Water Body Identification Number (WBID)	A number that uniquely identifies a water body in Idaho ties in to the Idaho Water Quality Standards and GIS information.
Wetland	An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.
Young of the Year	Young fish born the year captured, evidence of spawning activity.

Appendix A. Unit Conversion Chart

Table A1. Metric - English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi.)	Kilometers (km)	1 mi. = 1.61 km 1 km = 0.62 mi.	3 mi. = 4.83 km 3 km = 1.86 mi.
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square Feet (ft^2) Square Miles (mi^2)	Hectares (ha) Square Meters (m^2) Square Kilometers (km^2)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft^2 = 0.09 m^2 1 m^2 = 10.76 ft^2 1 mi^2 = 2.59 km^2 1 km^2 = 0.39 mi^2	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft^2 = 0.28 m^2 3 m^2 = 32.29 ft^2 3 mi^2 = 7.77 km^2 3 km^2 = 1.16 mi^2
Volume	Gallons (g) Cubic Feet (ft^3)	Liters (l) Cubic Meters (m^3)	1 g = 3.78 l 1 l = 0.26 g 1 ft^3 = 0.03 m^3 1 m^3 = 35.32 ft^3	3 g = 11.35 l 3 l = 0.79 g 3 ft^3 = 0.09 m^3 3 m^3 = 105.94 ft^3
Flow Rate	Cubic Feet per Second (ft^3/sec)[1]	Cubic Meters per Second (m^3/sec)	1 ft^3/sec = 0.03 ^{3}/sec 1 m^3/sec = ft^3/sec	3 ft^3/sec = 0.09 m^3/sec 3 m^3/sec = 105.94 ft^3/sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/l)	1 ppm = 1 mg/l[2]	3 ppm = 3 mg/l
Weight	Pounds (lbs.)	Kilograms (kg)	1 lb. = 0.45 kg 1 kg = 2.20 lbs.	3 lb. = 1.36 kg 3 kg = 6.61 kg
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 ° C = 37.4 °F

[1] 1 ft^3/sec = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 ft^3/sec.
[2] The ratio of 1 ppm = 1 mg/l is approximate and is only accurate for water.

Appendix B. 5th Field Statistics

Table B1. 5th Field Statistics.

Upper Owyhee 4th Field HUC	Statistics
Land Use	
Rangeland	889,562 acres (88%)
Irrigated Gravity	1,493 acres (<1%)
Irrigated Sprinkler	2,396 acres (<1%)
Riparian	42,856 acres (4%)
Forested	76,108 acres (7.5%)
Ownership/Management	
Private	65,653 acres (6.5%)
State of Idaho	73,428 acres (7.3%)
Federal/Bureau of Land Management	746,833 acres (73.8%)
Federal/Tribal Lands	122,375 acres (12.1%)
Open Water	4,117 acres (0.4%)
5th Field HUCs	
Blue Creek	129,460 acres (11.8%)
Blue Creek Reservoir	136,477 acres (12.5%)
Deep Creek	71,598 acres (6.5%)
Lower Battle Creek	82,525 acres (7.5%)
Hurry Back Creek	98,405 acres (9.0%)
Lower Owyhee River	53,428 acres (4.9%)
Paiute Creek	50,634 acres (4.6%)
Pole Creek	54,550 acres (5.0%)
Red Canyon	49,898 acres (4.6%)
Ross Lake	110,009 acres (10.1%)
Dickshooter Creek	49,010 acres (4.5%)
Upper Battle Creek	100,653 acres (9.2%)
Yatahoney Creek*	107,994 acres (9.8%)
303(d) Listed Segments	
Blue Creek Reservoir	
Pollutants of Concern	Sediment
Juniper Basin Reservoir	749 acres
Pollutants of Concern	Sediment
Deep Creek	35.0 miles
Pollutants of Concern	Temperature and Sediment
Pole Creek	24.1 miles
Pollutants of Concern	Temperature and Sediment

Castle Creek	11.3 miles
Pollutants of Concern	Temperature and Sediment
Battle Creek	62.5 miles
Pollutants of Concern	Bacteria
Shoofly Creek	22.9 miles
Pollutants of Concern	Temperature and Sediment
Red Canyon Creek	5.2 miles
Pollutants of Concern	Temperature and Sediment
Nickel Creek	2.8 miles
Pollutants of Concern	Sediment

* Portions within state of Nevada

Table B2. Blue Creek 5th Field HUC Statistics.

Blue Creek 5th Field HUC	Statistics
Total Area	129,460 acres
0-1st Order Streams	92.5 miles
2nd Order Streams	50.0 miles
3rd Order Streams	14.8 miles
4th Order Streams	16.6 miles
5th Order Streams	
Canal Ditches	59.1 miles
Other	6.2 miles
§303(d) Listed Segments	
Shoofly Creek	1.6 miles
Listed Pollutant	Bacteria
Land Use	
Rangeland	94,039 acres
Irrigated	1,982 acres
Land Ownership/Management	
Private	10,320 acres
State of Idaho	14,955 acres
Federal (BLM)	11,101 acres
Open Water	535 acres
Federal (Tribal)	59,112 acres
Other Water Bodies	
Bell Creek	9.2 miles
Blue Creek	15.2 miles
Boyle Creek	4.5 miles
Damon Creek	2.6 miles
Dry Creek	7.0 miles
Indian Creek	4.8 miles
Miller Creek	6.3 miles
Moorcastle Creek	4.4 miles
Mountain View Lake	2.4 miles
Mud Creek	6.2 miles
Old Man Creek	5.2 miles
Papoose Creek	5.6 miles
Payne Creek	11.7 miles
Pig Creek	7.5 miles
Squaw Creek	16.0 miles

Blue Creek 5th Field HUC	Statistics
Thacker Slough	3.6 miles
Unnamed	117.3 miles

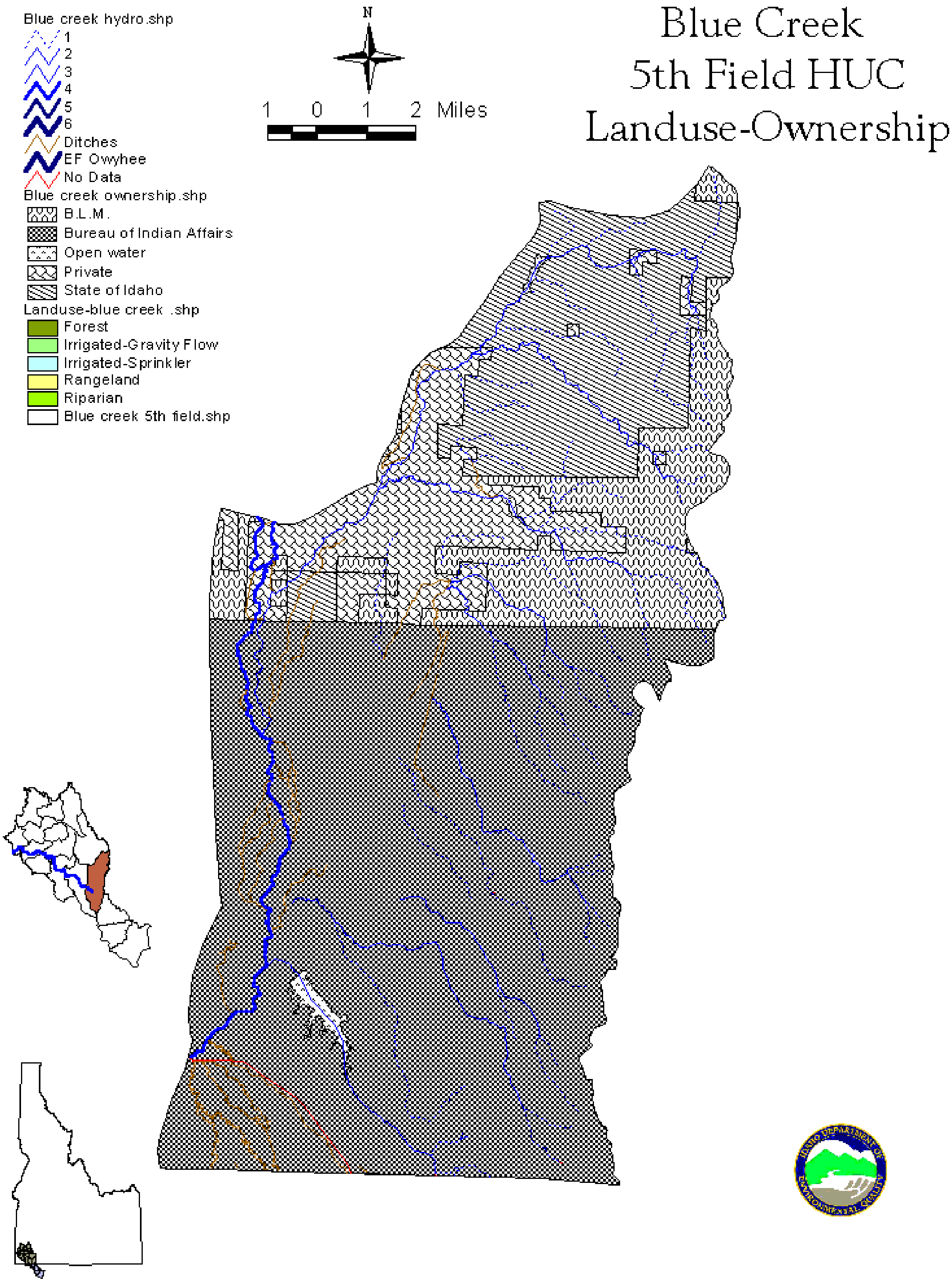
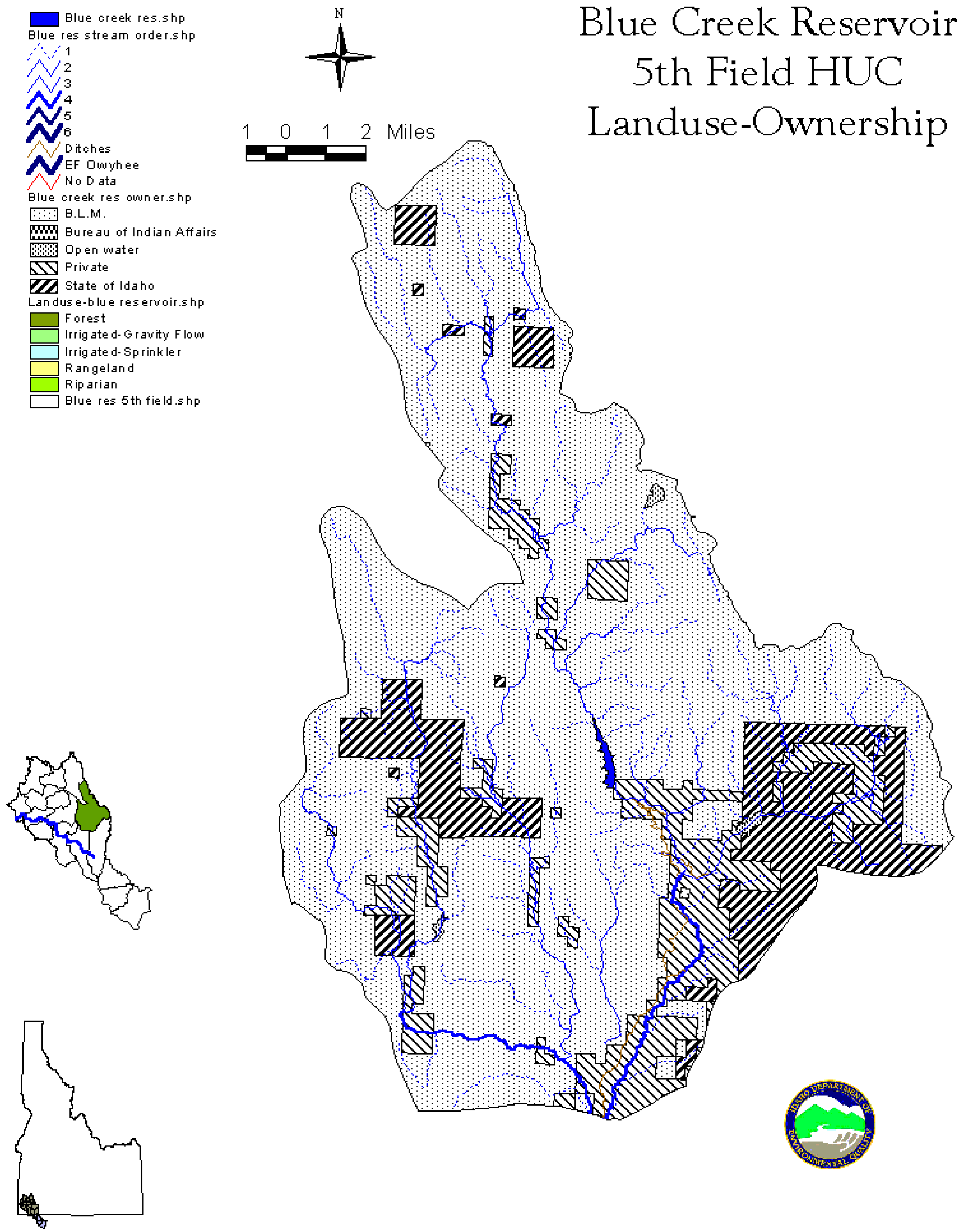
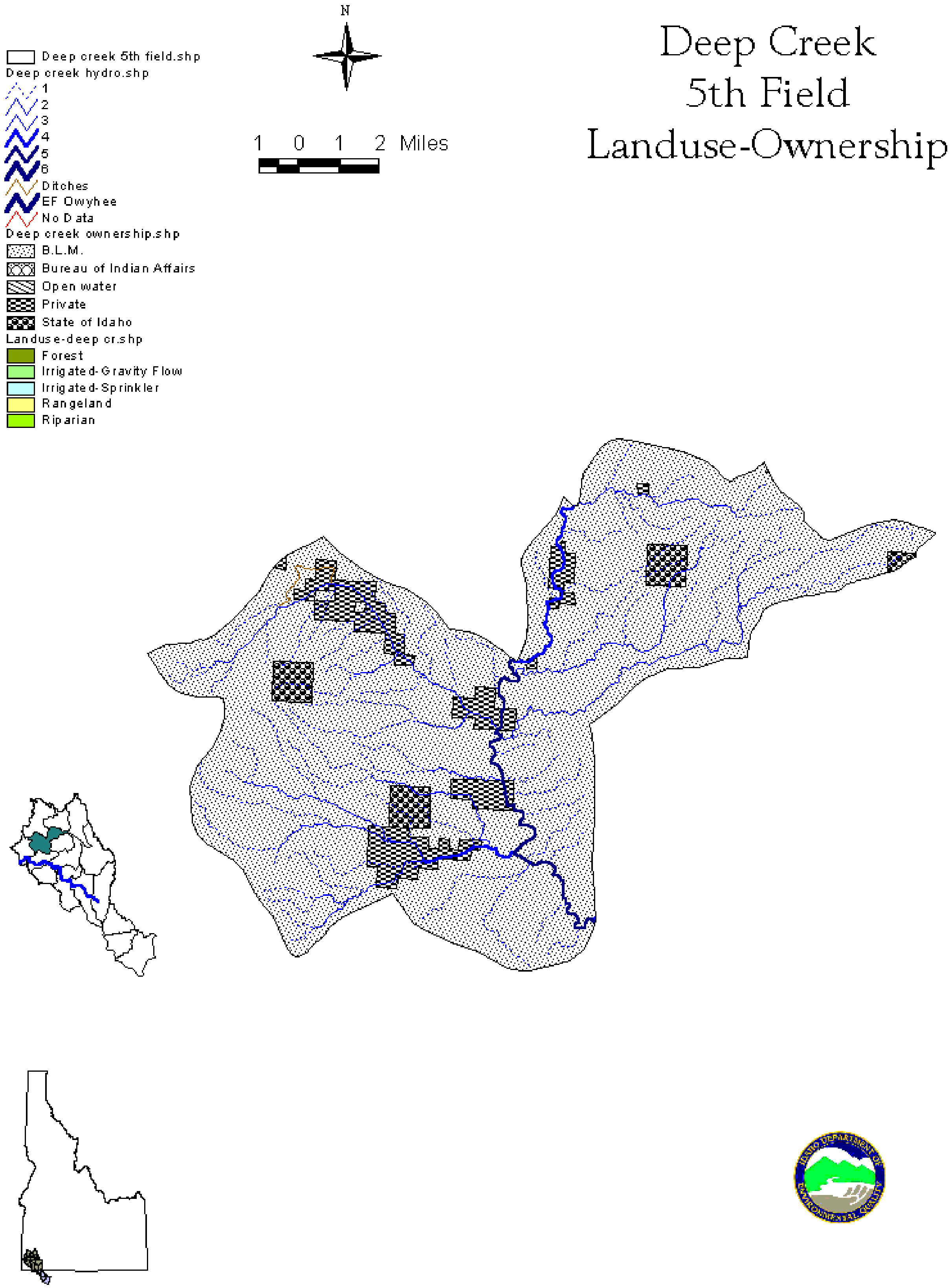

Blue Creek
5th Field HUC
Landuse-Ownership
N
1 0 1 2 Miles
Blue creek hydro.shp
1
2
3
4
5
6
Ditches
EF Owyhee
No Data
Blue creek ownership.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Landuse-blue creek .shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian
Blue creek 5th field.shp

Table B3. Blue Creek Reservoir 5th Field HUC Statistics.

Blue Creek Reservoir	Statistics
5th Field HUC	
Total Area	136,477 acres
0-1st Order Streams	207.9 miles
2nd Order Streams	51.8 miles
3rd Order Streams	49.2 miles
4th Order Streams	16.5 miles
Canals/Ditches	13.4 miles
§303(d) Listed Segments	
Shoofly Creek	21.4 miles
Listed Pollutant	Bacteria
Blue Creek Reservoir	185 acres
Listed Pollutant	Sediment
Land Use	
Rangeland	136,062 acres (99%)
Irrigated	418 acres (<1%)
Land Ownership/Management	
Private	17,182 acres (12.7%)
State of Idaho	17,462 acres (12.8%)
Federal (BLM)	101,182 acres (74.1%)
Open Water	494 acres (<.1%)
Other Water Bodies	
Blue Creek	33.3 miles
Little Blue Creek	10.1 miles
Harris Creek	11.3 miles
Bybee Reservoir	
Little Blue Creek Reservoir	


Blue Creek Reservoir
5th Field HUC
Landuse-Ownership
Blue creek res.shp
Blue res stream order.shp
1
2
3
4
5
6
Ditches
EF Owyhee
No Data
Blue creek res owner.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Landuse-blue reservoir.shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian
Blue res 5th field.shp
N
1 0 1 2 Miles

Deep Creek 5th Field HUC	Statistics
Total Area	71,598 acres
0-1st Order Streams	138.0 miles
2nd Order Streams	41 miles
3rd Order Streams	15.7 miles
4th Order Streams	10.7 miles
5th Order	11.8 miles
Canals/Ditches	2.8 miles
§303(d) Listed Segments	
Deep Creek	11.8 miles
Listed Pollutants(s)	Temperature/Sediment
Castle Creek	11.3 miles
Listed Pollutant	Temperature/Sediment
Pole Creek	5.6 miles
Listed Pollutants(s)	Temperature/Sediment
Land Use	
Rangeland	60,102.2 acres
Irrigated	
Forest	9,945.6 acres
Riparian	1,550.4 acres
Land Ownership/Management	
Private	4976 acres
State of Idaho	2066 acres
Federal (BLM)	64,556 acres
Other Water Bodies	
Beaver Creek	9.0 miles
Bull Gulch	0.4 miles
Carter Creek	3.7 miles
Cowboy Creek	6.3 miles
Dickshooter Creek	2.5 miles
Jobe Creek	1.5 miles
Lightening Creek	4.4 miles
Long Meadow Creek	5.4 miles
Moonshine Creek	2.4 miles
Skunk Creek	2.4 miles
Swisher Creek	2.1 miles
Brace Reservoir	


Deep Creek
5th Field
Landuse-Ownership
N
1 0 1 2 Miles
Deep creek 5th field.shp
Deep creek hydro.shp
1
2
3
4
5
6
Ditches
EF Owyhee
No Data
Deep creek ownership.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Landuse-deep cr.shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian

Lower Battle Creek 5th Field HUC	Statistics
Total Area	82,523 acres
0-1st Order Streams	112.1 miles
2nd Order Streams	24.1 miles
3rd Order Streams	4.6 miles
4th Order Streams	29.1 miles
§303(d) Listed Segments	
Battle Creek	29.0 miles
Listed Pollutants(s)	Bacteria
Land Use	
Rangeland	70,995 acres
Riparian	11,530 acres
Land Ownership/Management	
Private	539 acres
State of Idaho	2,886 acres
Federal (BLM)	79,098 acres
Other Water Bodies	
Cottonwood Draw	3.7 miles
Freshwater Draw	6.6 miles
Kelly Park	7.4 miles
Owyhee River	15.7 miles
Yatahoney Creek	3.8 miles
Unnamed	123.5 miles

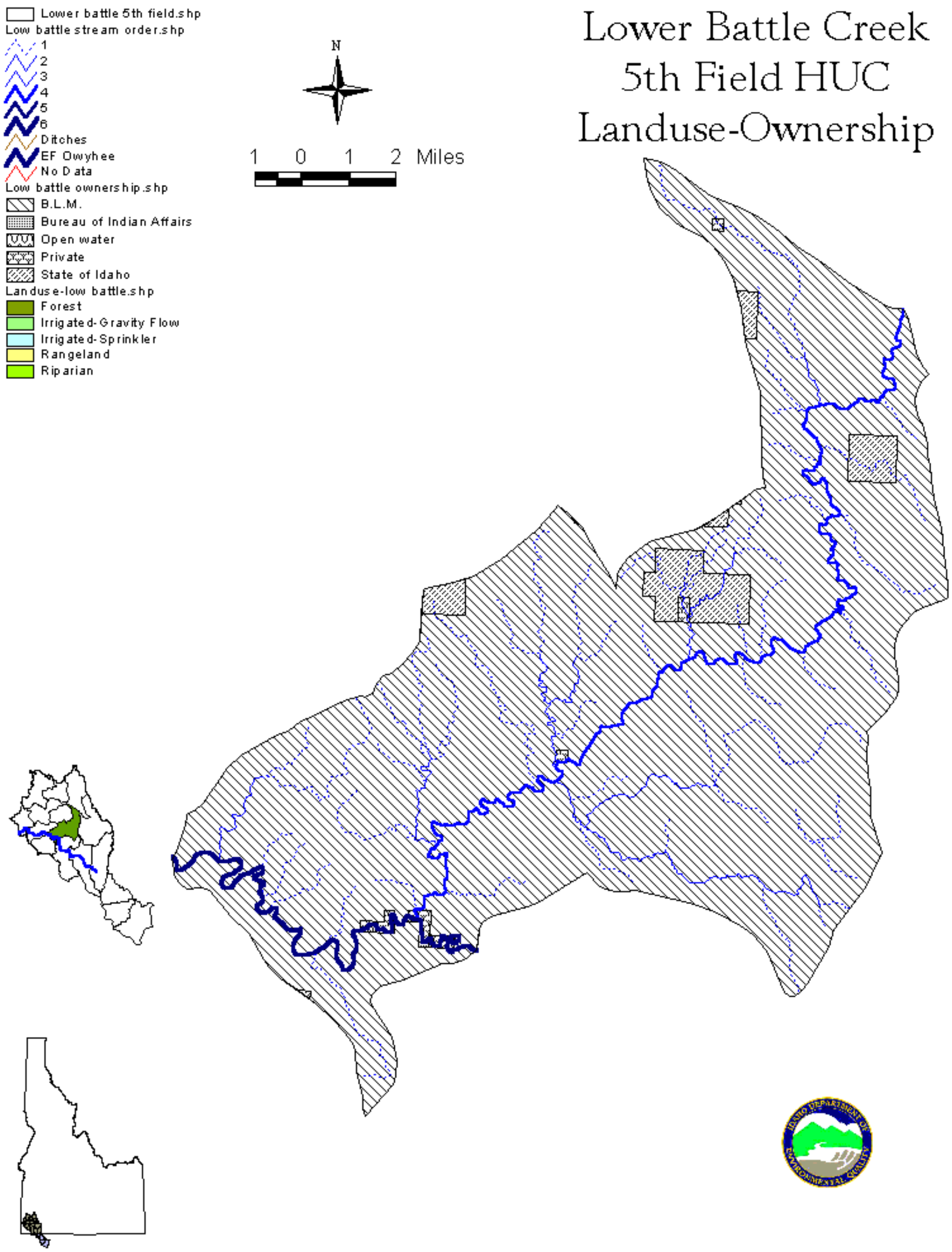

Lower Battle Creek
5th Field HUC
Landuse-Ownership
Lower battle 5th field.shp
Low battle stream order.shp
1
2
3
4
5
6
Ditches
EF Owyhee
No Data
Low battle ownership.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Landuse-low battle.shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian
N
1 0 1 2 Miles

Table B4. Hurry Back Field HUC Statistics.

Hurry Back 5th Field HUC	Statistics
Total Area	98,406 acres
0-1st Order Streams	179.2 miles
2nd Order Streams	57.4 miles
3rd Order Streams	15.8 miles
4th Order Streams	23.4 miles
5th Order Streams	4.8 miles
Canals/Ditches	6.4 miles
§303(d) Listed Segments	
Deep Creek	13.0 miles
Listed Pollutant	Temperature/Sediment
Pole Creek	2.5 miles
Listed Pollutant	Temperature/Sediment
Nickel Creek	2.8 miles
Listed Pollutant	Sediment
Other Water Bodies	
Anne Valley Creek	9.3 miles
Corral Creek	5.4 miles
Cow Valley Canyon	2.5 miles
Crooked Creek	3.0 miles
Current Creek	13.6 miles
Deep Creek	13 miles
Hidden Valley Creek	2 miles
Hurry Back Creek	11.2 miles
Hurry Up Creek	4.8 miles
Jackass Creek	1.9 miles
Little Smith Creek	4.2 miles
Little Thomas Creek	6.2 miles
Nickel Creek	13.7 miles
Nip and Tuck Creek	9.1 miles
Pleasant Valley Creek	5.5 miles
Pole Creek	2.5 miles
Slack Creek	3.7 miles
Smith Creek	7.1 miles
Stoneman Creek	3.9 miles
Thomas Creek	4.7 miles

Unnamed	158 miles
Land Use	
Rangeland	49,694.4 acres
Forest	45,816.7 acres
Riparian	2891.3 acres
Land Ownership/Management	
Private	12,453 acres
State of Idaho	17,143 acres
Federal (BLM)	68,795 acres
Open Water	15 acres

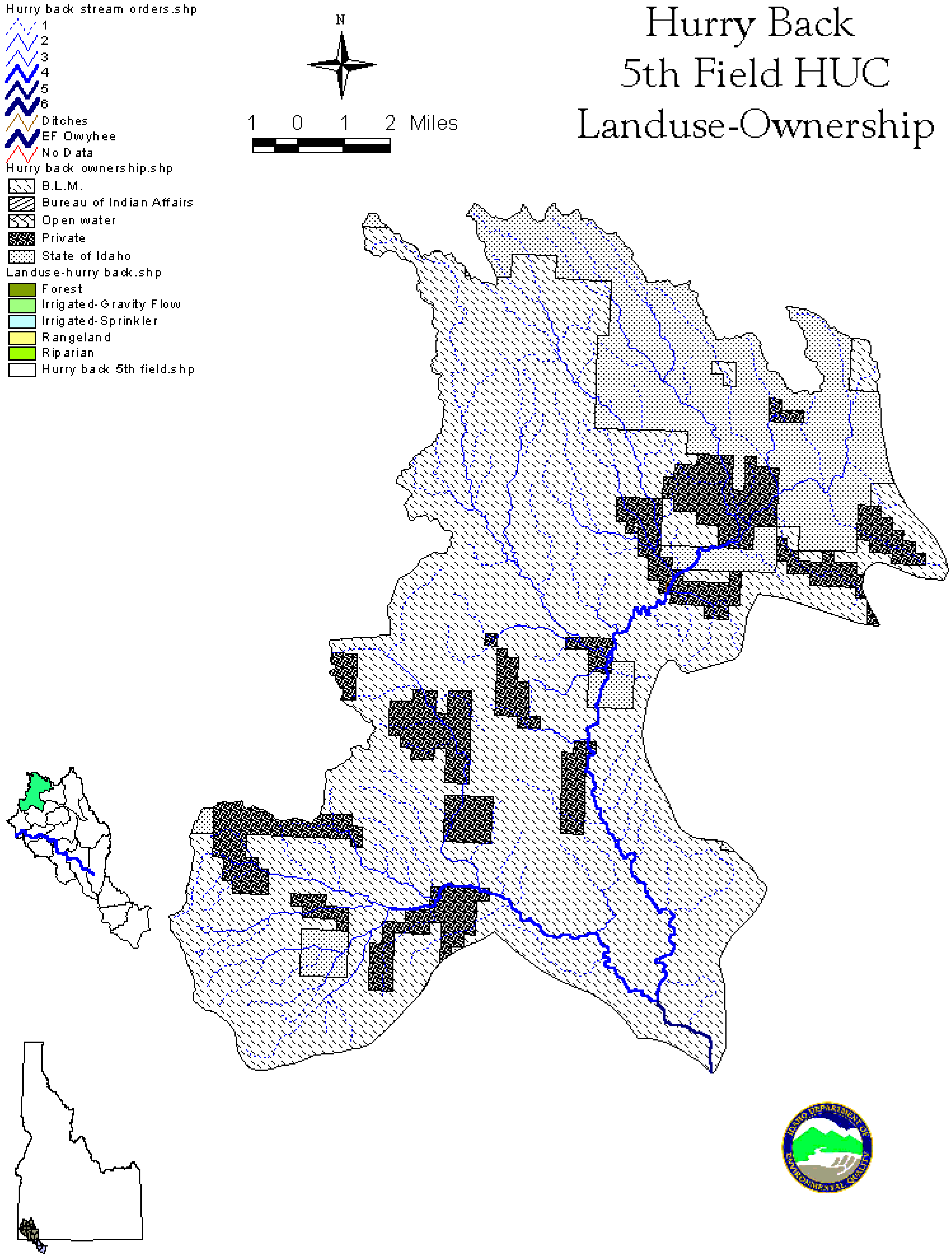

Hurry Back
5th Field HUC
Landuse-Ownership
Hurry back stream orders.shp
1
2
3
4
5
6
Ditches
EF Owyhee
No Data
Hurry back ownership.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Landuse-hurry back.shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian
Hurry back 5th field.shp
N
1 0 1 2 Miles

Table B5. Lower Owyhee 5th Field HUC Statistics.

Lower Owyhee 5th Field HUC	Statistics
Total Area	
0-1st Order Streams	62.7 miles
2nd Order Streams	0.3 miles
3rd Order Streams	14.8 miles
5th Order Streams	11.6 miles
EF Owyhee River	20.3 miles
§303(d) Listed Segments	
Deep Creek	
Listed Pollutant	Temperature Sediment
Other Water Bodies	
Cherry Gulch	3.1 miles
Paiute Creek	1.4 miles
Porcupine Creek	7.3 miles
Unnamed	67.5 miles
Land Use	
Rangeland	47,969 acres
Riparian	5,459 acres
Land Ownership/Management	
Private	168 acres
State of Idaho	595 acres
Federal (BLM)	52,664 acres

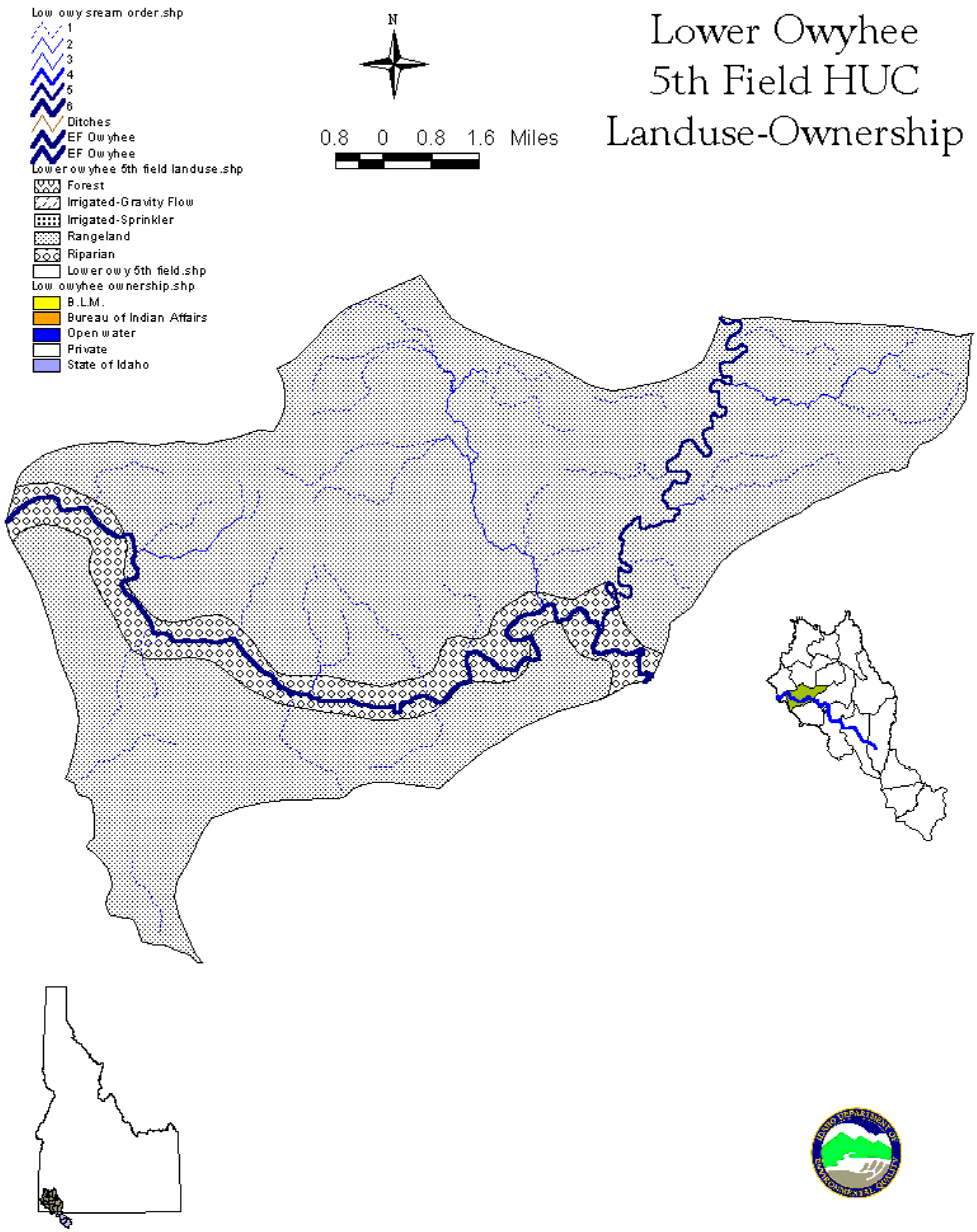

Low owy sream order.shp
1
2
3
4
5
6
Ditches
EF Owyhee
EF Owyhee
Lower owyhee 5th field landuse.shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian
Lower owy 5th field.shp
Low owyhee ownership.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
N
0.8 0 0.8 1.6 Miles
Lower Owyhee
5th Field HUC
Landuse-Ownership

Table B6. Paiute Creek 5th Field HUC Statistics.

Paiute Creek5th Field HUC	Statistics
Total Area	50,634 acres
0-1st Order Streams	91.0 miles
2nd Order Streams	20.2 miles
3rd Order Streams	8.7 miles
4th Order Streams	6.5 miles
5th Order Streams	
Canal/Ditches	0.1 miles
§303(d) Listed Segments	
none	
Other Water Bodies	
Paiute Creek	15.7 miles
Unnamed	110.8 miles
Land Use	
Rangeland	49,707 acres
Riparian	926.7 acres
Land Ownership/Management	
State of Idaho	2,696 acres
Federal (BLM)	47,938 acres

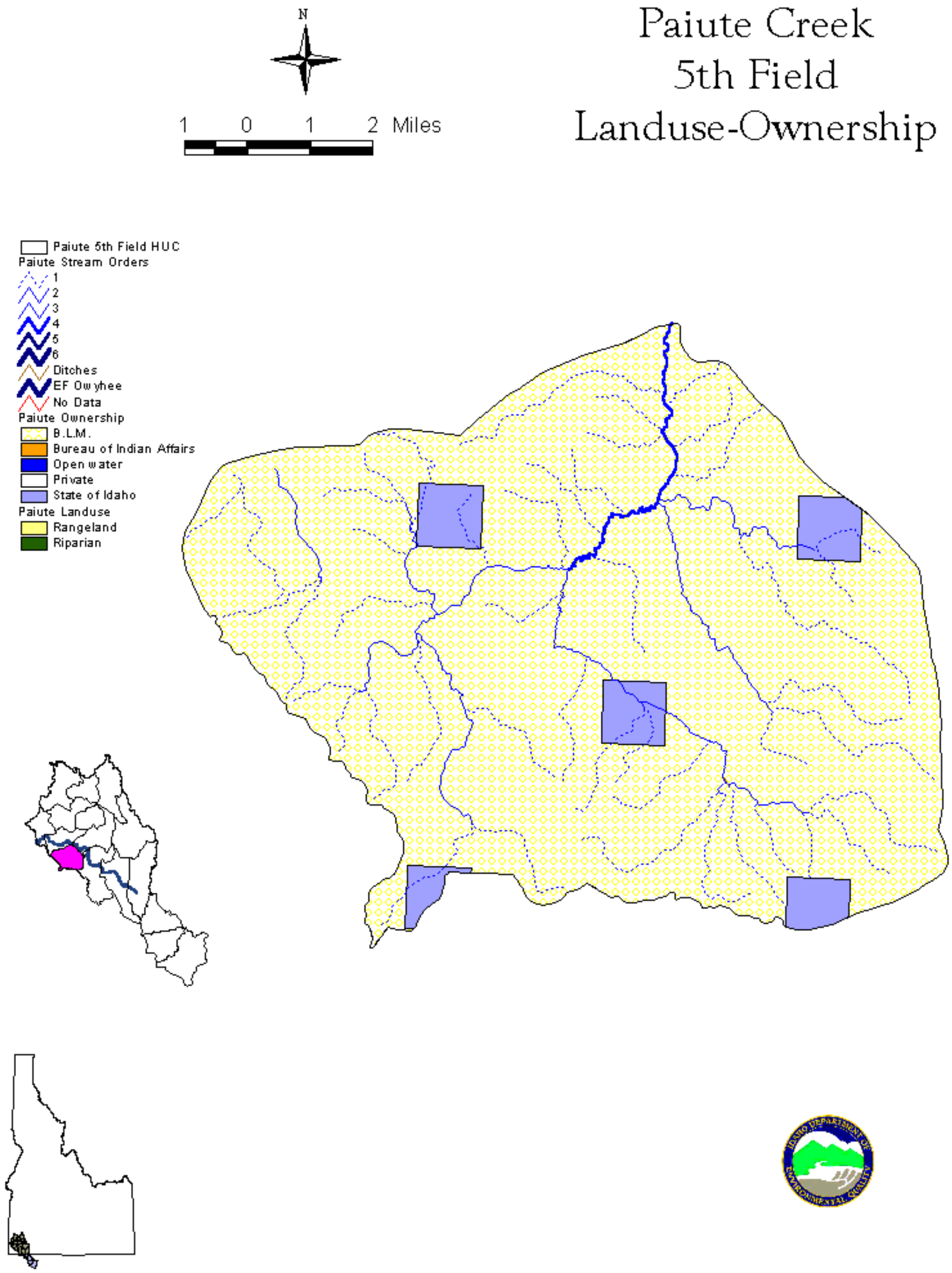

Paiute Creek
5th Field
Landuse-Ownership
N
1 0 1 2 Miles
Paiute 5th Field HUC
Paiute Stream Orders
1
2
3
4
5
6
Ditches
EF Owyhee
No Data
Paiute Ownership
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Paiute Landuse
Rangeland
Riparian

Table B7. Pole Creek 5th Field HUC Statistics.

Pole Creek 5th Field HUC	Statistics
Total Area	54,551 acres
0-1st Order Streams	100.1 miles
2nd Order Streams	17.7 miles
3rd Order Streams	15.7 miles
4th Order Streams	8.3 miles
Canals/Ditches	4.8 miles
§303(d) Listed Segments	
Pole Creek	19.2 miles
Listed Pollutants(s)	Temperature/Sediment
Other Water Bodies	
Camas Creek	14.0 miles
Camel Creek	5.4 miles
Slack Creek	5.5 miles
Sunshine Valley Creek	2.7 miles
Unnamed	99.8 miles
Land Use	
Rangeland	54,551 acres
Land Ownership/Management	
Private	5,763
State of Idaho	3507
Federal (BLM)	45,281

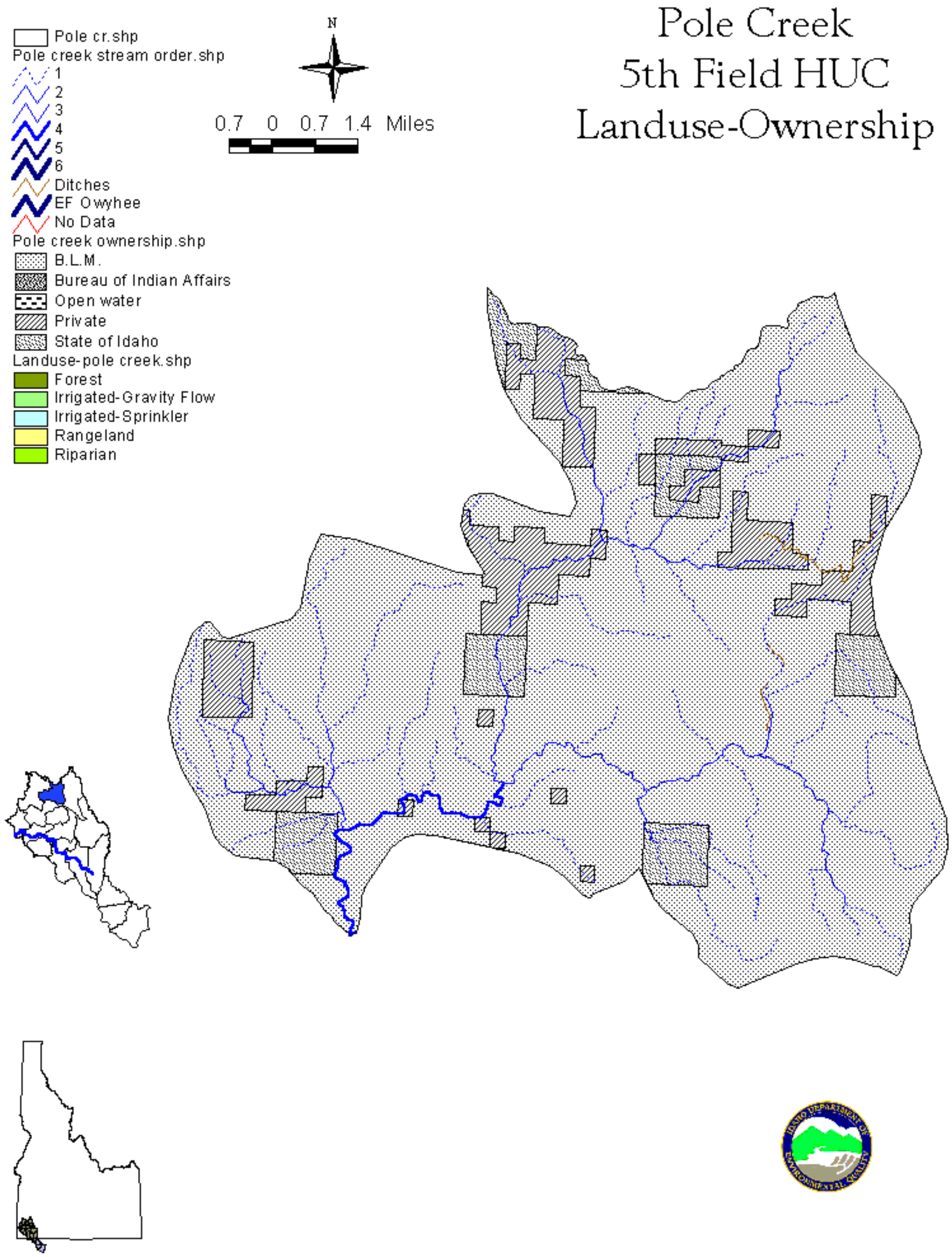

Pole Creek
5th Field HUC
Landuse-Ownership
Pole cr.shp
Pole creek stream order.shp
1
2
3
4
5
6
Ditches
EF Owyhee
No Data
Pole creek ownership.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Landuse-pole creek.shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian
N
0.7 0 0.7 1.4 Miles

Table B8. Red Canyon 5th Field Statistics.

Red Canyon 5th Field HUC	Statistics
Total Area	49,897.4 acres
0-1st Order Streams	83.6 miles
2nd Order Streams	23.5 miles
3rd Order Streams	13.8 miles
4th Order Streams	3.0 miles
5th Order Streams	7.5 miles
§303(d) Listed Segment	
Red Canyon Creek	5.1 miles
Listed Pollutant	Temperature/Sediment
Other Water Bodies	
Petes Creek	7.9 miles
Bull Basin Creek	7.2 miles
Red Basin Creek	8.3 miles
East Fork Red Canyon Creek	6.0 miles
West Fork Red Canyon Creek	8.2 miles
East Fork Owyhee River	7.2 miles
Cow Creek	4.0 miles
Land Use	
Rangeland	26,250.6 acres
Forest	20,343.4 acres
Riparian	3,303.3 acres
Land Ownership/Management	
Private	453 acres
Federal (BLM)	49,445 acres

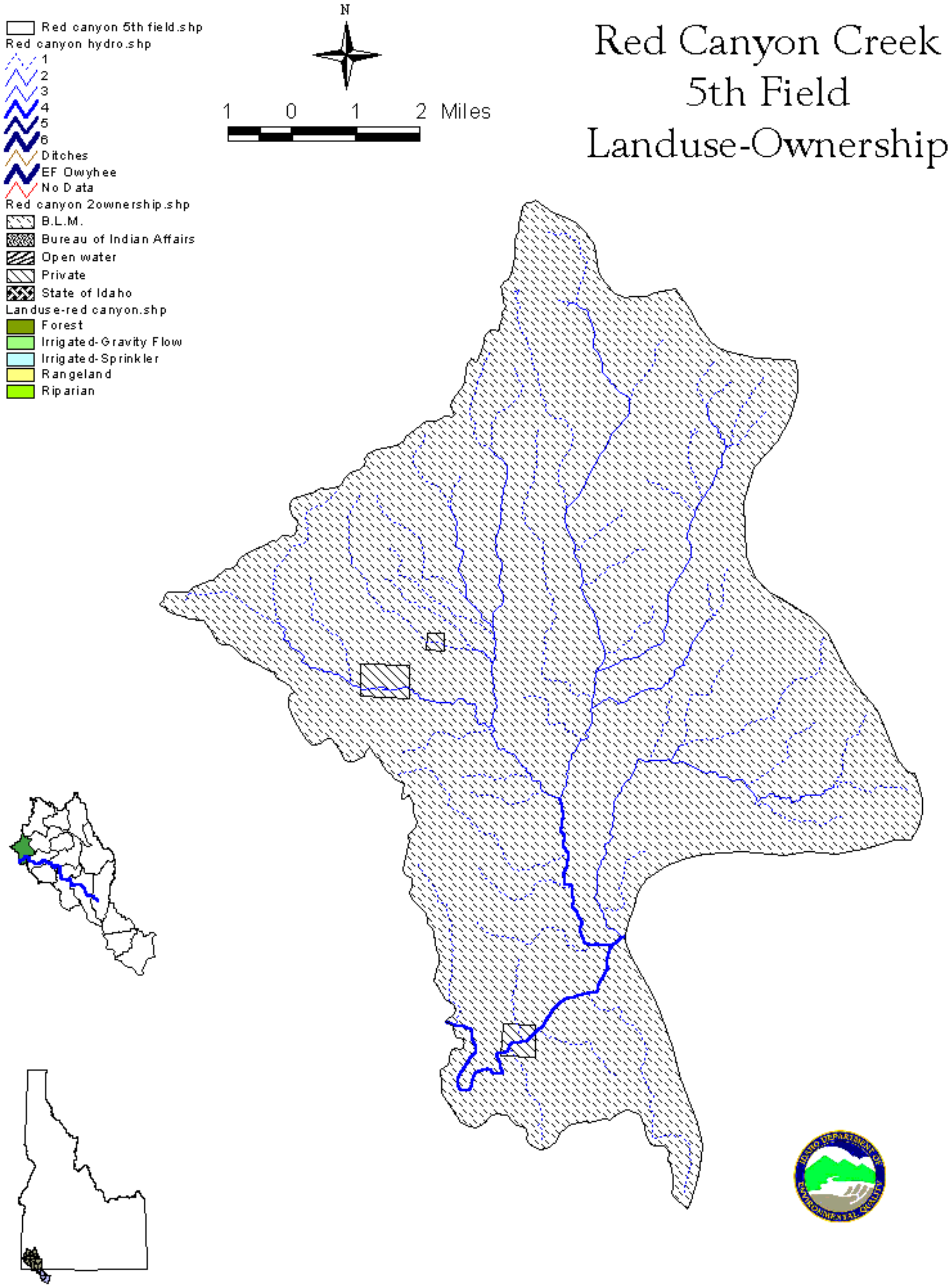

Red Canyon Creek
5th Field
Landuse-Ownership
N
1 0 1 2 Miles
Red canyon 5th field.shp
Red canyon hydro.shp
1
2
3
4
5
6
Ditches
EF Owyhee
No Data
Red canyon 2ownership.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Landuse-red canyon.shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian

Table B9. Ross Lake 5th Field HUC Statistics.

Ross Lake 5th Field HUC	Statistics
Total Area	110,009
0-1st Order Streams	88.3 miles
2nd Order Streams	19.3 miles
3rd Order Streams	5.8 miles
Canal/Ditches	17.0 miles
East Fork Owyhee	24.1 miles
§303(d) Listed Segments	
None	
Other Water Bodies	
Billy Shaw Slough	2.5 miles
Ross Slough	10.3 miles
Unnamed	112.0 miles
Land Use	
Rangeland	77,274 acres
Forest	acres
Riparian	1,452 acres
Land Ownership/Management	
Private	299 acres
State of Idaho	84 acres
Federal (BLM)	16,208 acres
Open Water	2,297 Acres
Federal (Tribal)	59,839 acres

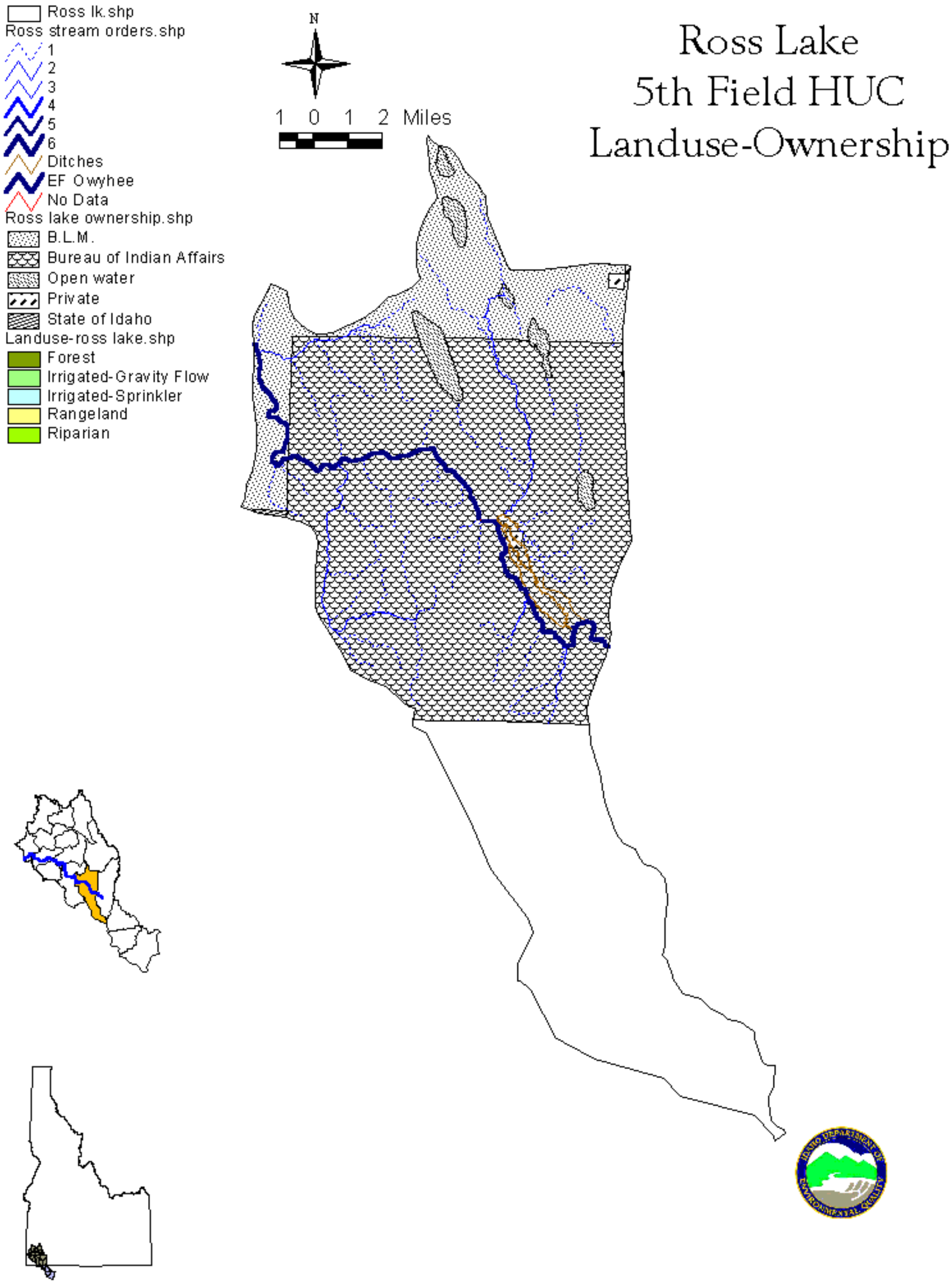

Ross Lake
5th Field HUC
Landuse-Ownership
Ross lk.shp
Ross stream orders.shp
1
2
3
4
5
6
Ditches
EF Owyhee
No Data
Ross lake ownership.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Landuse-ross lake.shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian
N
1 0 1 2 Miles

Table B10. Dickshooter 5th Field HUC Stats.

Dickshooter 5th Field HUC	Statistics
Total Area	49,010 acres
0-1st Order Streams	88.4 miles
2nd Order Streams	20.6 miles
3rd Order Streams	6 miles
4th Order Streams	14 miles
§303(d) Listed Segments	
None	
Listed Pollutants(s)	
Other Water Bodies	
Dickshooter Creek	22.5 miles
Unnamed	106.9 miles
Land Use	
Rangeland	49,009 acres
Land Ownership/Management	
Private	427 acres
State of Idaho	2678 acres
Federal (BLM)	45,904 acres

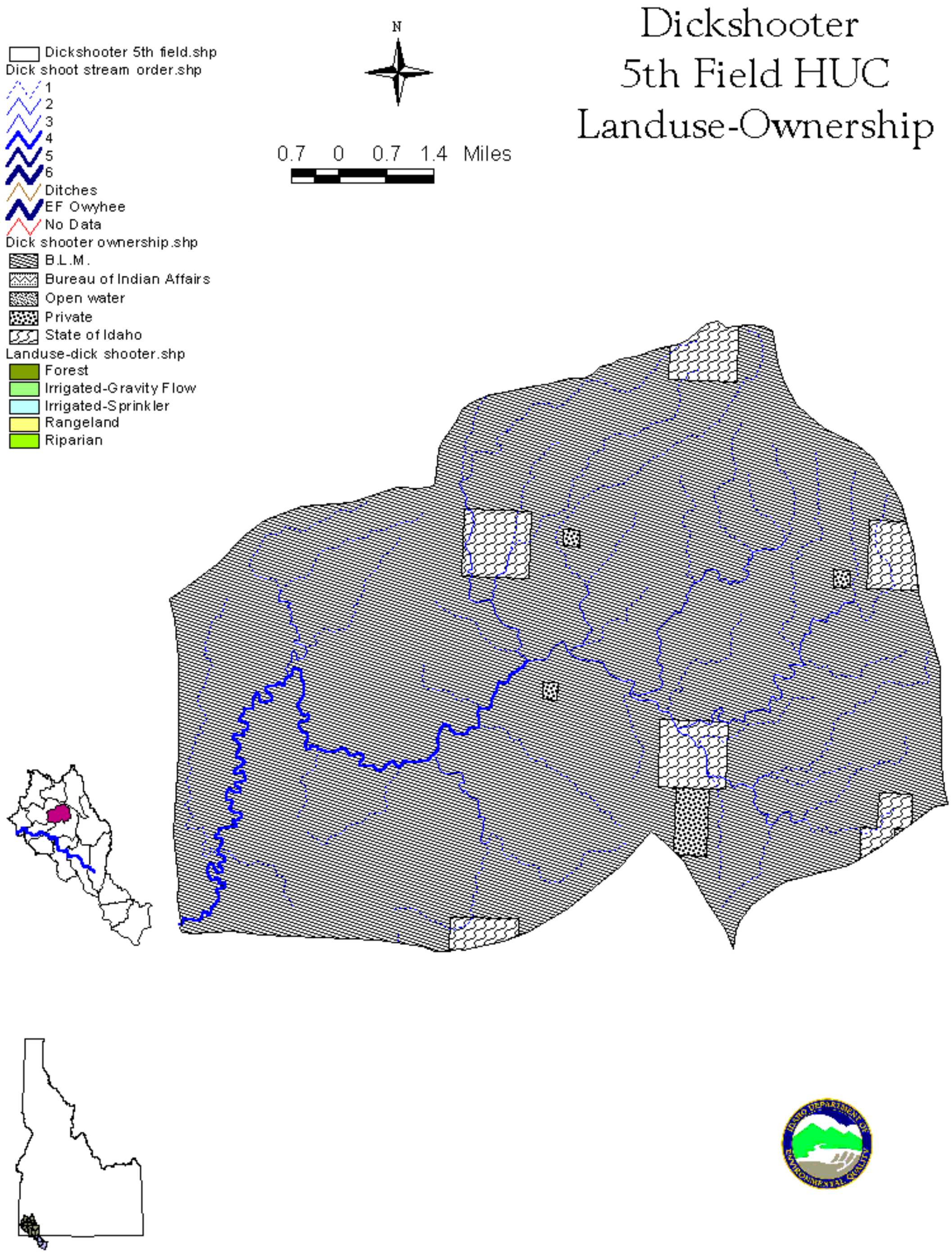

Dickshooter
5th Field HUC
Landuse-Ownership
N
0.7 0 0.7 1.4 Miles
Dickshooter 5th field.shp
Dick shoot stream order.shp
1
2
3
4
5
6
Ditches
EF Owyhee
No Data
Dick shooter ownership.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Landuse-dick shooter.shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian

Table B11. Upper Battle Creek 5th Field HUC Statistics.

Upper Battle Creek 5th Field HUC	Statistics
Total Area	100,651 acres
0-1st Order Streams	140.5 miles
2nd Order Streams	50.9 miles
3rd Order Streams	28.4 miles
4th Order Streams	2.7 miles
Canal/Ditches	26.7 miles
§303(d) Listed Segments	
Battle Creek	35.5 miles
Listed Pollutants(s)	Bacteria
Other Water Bodies	
Big Springs Creek	15.8 miles
Dry Creek	15.0 miles
Rock Creek	4.8 miles
Unnamed	178.1 miles
Land Use	
Rangeland	88,979.8 acres
Irrigated	1,493.3 acres
Riparian	10,178.6 acres
Land Ownership/Management	
Private	12,169 acres
State of Idaho	6,500 acres
Federal (BLM)	81,911 acres
Open Water	71 acres

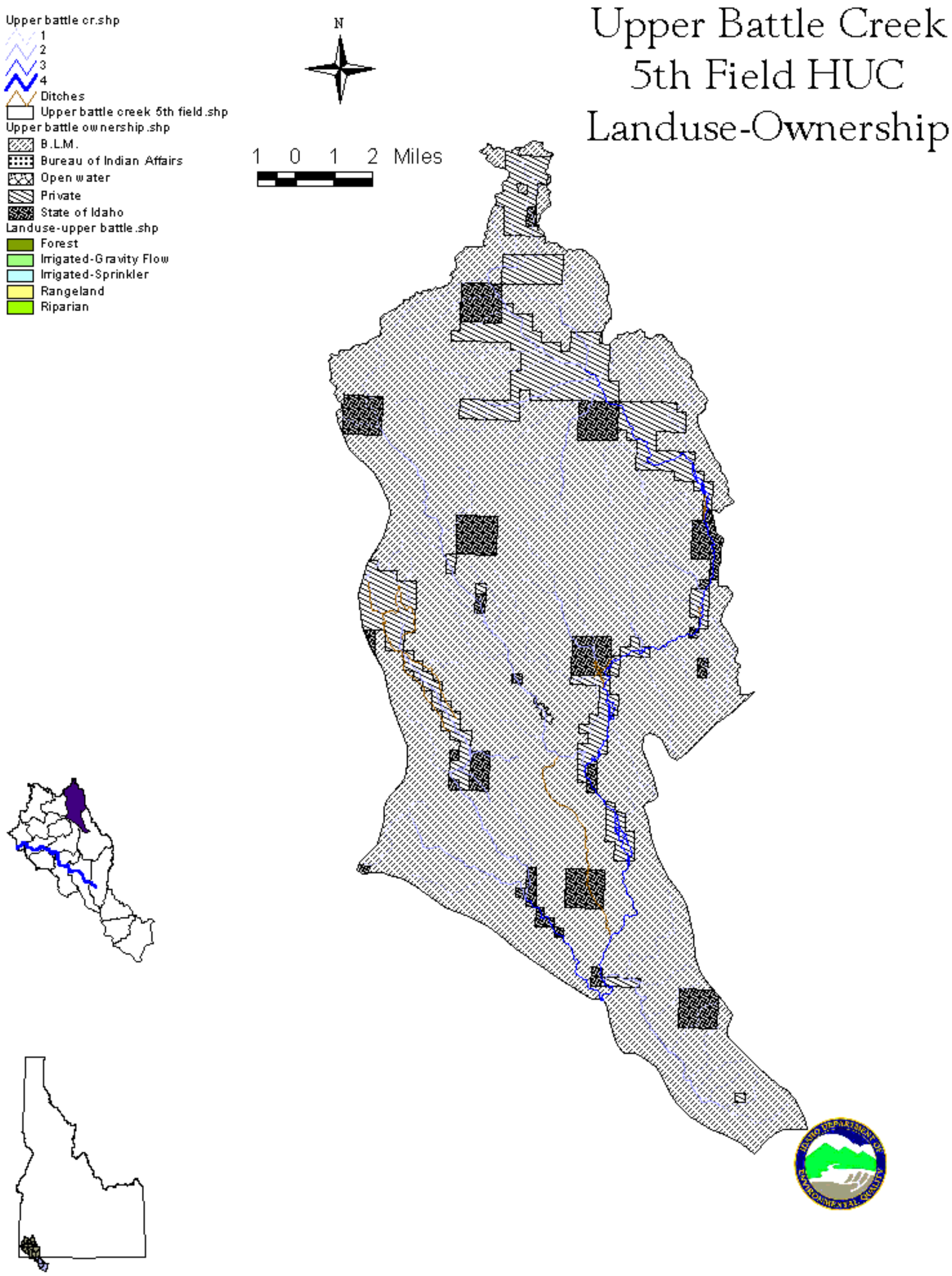
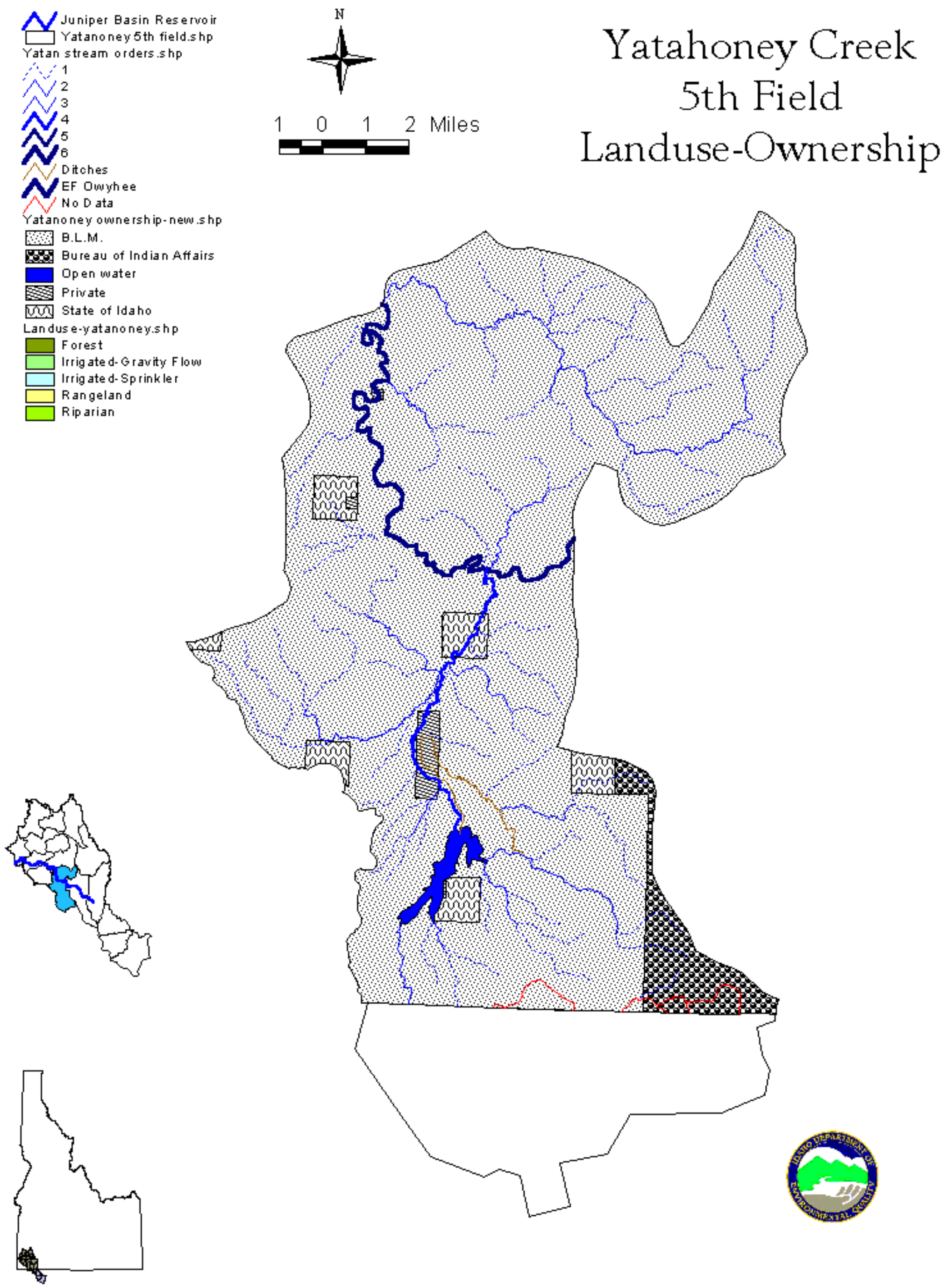

Upper Battle Creek
5th Field HUC
Landuse-Ownership
Upper battle cr.shp
1
2
3
4
Ditches
Upper battle creek 5th field.shp
Upper battle ownership.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Landuse-upper battle.shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian
N
1 0 1 2 Miles

Table B12. Yatahoney 5th Field HUC Statistics.

Yatahoney Creek 5th Field HUC	Statistics
Total Area	90,528 acres
0-1st Order Streams	118 miles
2nd Order Streams	34.8 miles
3rd Order Streams	12.9 miles
4th Order Streams	9.7 miles
6th Order	16.6 miles
Canals/Ditches	7.4 miles
§303(d) Listed Segments	
Juniper Basin Reservoir	749 acres
Listed Pollutant	Sediment
Other Water Bodies	
Juniper Creek	13.1 miles
Owyhee River	16.6 miles
Yatahoney Creek	19.9 miles
Unnamed	155.2 miles
Land Use	
Rangeland	84,920 acres
Riparian	5,563.3 acres
Land Ownership/Management	
Private	749 acres
State of Idaho	2,856 acres
Federal (BLM)	82,750 acres
Open Water	749 acres


Yatahoney Creek
5th Field
Landuse-Ownership
N
1 0 1 2 Miles
Juniper Basin Reservoir
Yatanoney 5th field.shp
Yatan stream orders.shp
1
2
3
4
5
6
Ditches
EF Owyhee
No Data
Yatanoney ownership-new.shp
B.L.M.
Bureau of Indian Affairs
Open water
Private
State of Idaho
Landuse-yatanoney.shp
Forest
Irrigated-Gravity Flow
Irrigated-Sprinkler
Rangeland
Riparian

Appendix C. Data Sources

Table C1. Data Sources for Upper Owyhee Watershed Subbasin Assessment.

Water Body	Data Source	Type of Data	When Collected
Deep Creek, Nickel Creek, Pole Creek, Castle Creek, Red Canyon Creek	Idaho Department of Environmental Quality, Boise Regional Office	Temperature	2000 and 2001
Battle Creek and Shoofly Creek	Idaho Department of Environmental Quality, Boise Regional Office	Bacteria	2000 and 2001
Juniper Basin Reservoir and Blue Creek Reservoir	Idaho Department of Environmental Quality, Boise Regional Office	Turbidity	2001
Pole Creek, Castle Creek, Deep Creek, Nickel Creek	United States Department of Interior, Bureau of Land Management	Fish	1999-2000
Various Streams in Watershed	Idaho Department of Environmental Quality, Boise Regional Office	Beneficial Use Reconnaissance Program Data	1991-1998

Appendix D. Stream Segment Temperature Model (SSTEMP) and Hydrology Model

Modeling Approach

SSTEMP and SSSHADE were the models used to assess the effects of solar radiation, channel morphology and instream flow on temperature in stream segments of the Upper Owyhee Watershed. The models were developed to help predict the consequences of manipulating various factors influencing water temperature. SSSHADE is a stream shading model which is used to provide input variables to the SSTEMP model. SSSHADE estimates stream shading from various riparian (vegetation) and topographic conditions

SSTEMP and SSSHADE require input data for 28 parameter and state variables ranging from channel conditions to climate. Many of these were kept constant for all model runs. Several parameters were varied to assess the impact of various factors. The following is a model input parameters are described below.

Input Values and Model Calibration

Stream Network Hydrology:

Segment Inflow: For all situations with streams with headwaters, this value was set at zero. For segments streams that are confluence of two streams this value was set at the addition of the flow from both water bodies. Flow was determined with the use of the flow model developed by Hortness and Berenbrock (2001). The flow model will be discussed later.

Inflow Temperature: For all situations with streams with headwaters, this value was set at 8.3^{o}C. For streams that are confluence of two streams this value was set based on the flow from both water bodies and the following formula:

$$T_j = \frac{(Q_1 * T_1) + (Q_2 * T_2)}{Q_1 + Q_2}$$

where: T_j = water temperature below junction
Q_n = discharge of source n
T_n = water temperature of source n

Stream Outflow: This value was obtained by calculating the inflow through the discharge model (Hortness and Berenbrock 2001). There is no allowance for reaches that are losing or gaining reaches. Thus, discharge is a steady state where outflow equals inflow from the beginning of the reach plus any inflow determined by the hydrology model.

Accretion Temperature: This the expected ground water temperature. This value is calculated by determining the average yearly temperature. Using the average yearly temperature obtained from the National Weather Service at the Boise City Municipal Airport (Boise, Idaho), a ground water temperature of 8.3^{o} C was obtained. To calculate the difference in the average yearly temperature the following formula was used:

$$T_a = T_o + C_t * (Z – Z_0)$$

where: T_a = average yearly air temperature at elevation E (^oC)
T_o = average air temperature at elevation Eo (^oC)
Z = Mean elevation of segment
Z_o = elevation at station (Boise)
C_t = moist adiabatic lapse rate (-0.00656 $^oC/m$)

<u>Stream Network Geometry:</u>

Segment Lengths: Derived from the stream reach length from GIS coverages.

Latitude: Used 0.733 radians (42.0^o) for all segments representing the lowest latitude of the study area.

Dams at Heads of Segments: No dams were figured into the model.

Upstream Elevation: Determined for each stream reach from USGS 7.5-minute quad maps.

Downstream Elevation: Determined for each stream reach from USGS 7.5-minute quad maps.

Width's A Term: The initial value was determined with the model. The width/depth ratio was set near 25 for all streams. The width/depth ratio was set at this value based on the limited BURP data. Width was then calculated through the model based on discharge (flow) input and calculated stream gradient. The width value was changed to obtain a possible width/depth ratio of near 12 to obtain a possible value once stream morphology conditions improve in response to changes in riparian vegetation and streambank conditions.

The use of the wetted width is an accepted input parameter if the stream width is not varied during the model run (Bartholow 1999). If wetted width is used, then the width's B Term is zero.

B Term where W = A*Q*B: This input is a calculated formula using available flow data. With limited flow data for the Upper Owyhee Watershed, this value was set at zero.

Manning's n: A default value of 0.035 was used because of the variability of substrate in the Upper Owyhee Watershed. The substrate varies from sand-silt to large boulders. The gradient can vary from 1-6%.

Stream Network Meteorology:

Air Temperature: The daily mean air temperature for the month of June was calculated from the mean daily temperature from the National Weather Service in Boise, Idaho. The Boise mean daily air temperature was used due to the fact that field data temperature loggers could not be in place early in the season due to travel difficulties and reluctance to leave data loggers out through the winter. To compensate for the possible difference in air temperature from Boise to the Upper Owyhee Watershed, the following formula was used:

$$T_a = T_o + C_t * (Z - Z_0)$$

where: T_a = average yearly air temperature at elevation E (^oC)
T_o = average air temperature at elevation Eo (^oC)
Z = Mean elevation of segment
Z_o = elevation at station (Boise)
C_t = moist adiabatic lapse rate (-0.00656 $^oC/m$)

Daily mean air temperatures for the months of July and August were calculated using temperature data recorded by data loggers in place in the watershed. The ambient air temperature-monitoring site was located at approximately 1,500 meters (4921 feet) elevation near the confluence of Castle Creek and Deep Creek.
Maximum Air Temperature: For the month of June the model calculated the monthly maximum temperature. Once again the lack of data prevented the use of actual in-field data. With the high probability of a wide variance of data from the beginning of the month to the end of the month, it was decided the model would be sufficient for calculating the mean monthly maximum air temperature for June.

For July and August, the actual mean monthly air temperature was used. The ambient air temperature monitoring site was located at approximately 1,500 meters (4921 feet) elevation near the confluence of Castle Creek and Deep Creek.

Relative Humidity: Relative humidity was set at 61.2% for the months of June, July and August. This value was determined sing the average relative humidity obtained from the National Weather Service in Boise, Idaho. The value obtained from Boise was then corrected for elevation using the following formula:

$$Rh = R_o*[1.6040\text{^}(T_o-T_a)] * [T_a+273.16)/(T_o+273.16)]$$

where: Rh = relative humidity for temperature T_a
R_o = relative humidity at station T_a
T_a = air temperature at segment
To = air temperature at station
^ = exponentiation

$$0 <= Rh <= 1$$

Wind Speed: The value obtained was from the National Weather Service in Boise, Idaho and averaged for June, July and August.

Ground Temperature: Using the average yearly air temperature obtained from the National Weather Service at the Boise City Municipal Airport (Boise, Idaho) after calibrating for altitude difference the value of 8.3^{o}C was obtained. To calculate the difference in the average yearly temperature the following formula was used:

$$T_a = T_o + C_t * (Z - Z_0)$$

where: T_a = average yearly air temperature at elevation E (^oC)
T_o = average air temperature at elevation Eo (^oC)

Z = Mean elevation of segment
Z_o = elevation at station (Boise)
C_t = moist adiabatic lapse rate (-0.00656 $^oC/m$)

Thermal Gradient: A default setting of 1.65joules/m^2/second was used.

Possible Sun: This value was obtained from the National Weather Service in Boise, Idaho and averaged for June, July and August. Value set at 76% for all three months of the model run.

Dust Coefficient: The input value was set at 6 units for entire run of the model. The input value range is 3 to 10 as supplied by Bartholow (1999) and taken from Tennessee Valley Authority (1972). The middle value was used as the input value due to a lack of data.

Ground Reflectivity: The input value was set at 15 and represents flat ground and rock (range 12-15). The high value was selected due to bare soils with high amounts of silt and sand in the surrounding soils.

Solar Radiation: Model defined.

Stream Network Shade:

Shade: Model generated based on input values for calibration. Shade then adjusted to obtain WQS criteria. Shade contains both topographic and vegetation shade. Topographic shade determined by value input from topographic attitude. Vegetation shade is then determined by model as shade increases. That is, since the topographic shade is a steady state input, as total shade is increased this would represent an increase in vegetation shade.

Stream Network Optional Shading Parameters:

Shading parameters are optional inputs. For the Upper Owyhee these values were entered during calibration reasons. Most of the values were entered using available data. In most incidences, once the required reductions (Joules/m^2/sec) were calculated these parameters were ignored by the model.

Segment Azimuth: This was determined from USGS 7.5-minute topographic maps. Since most streams have a general north to south flow (headwaters to mouth) this input value was set at zero (0.00 radians) for most streams. Two streams have northwest to southeast and southwest to northwest aspects with the input value set at either +45^o (+(0.785 radians)) or –45^o (–0.785 radians).

Topographic Attitude: This input value was the most difficult to determine and was usually set at 45^o (0.785 radians) due to the steepness of the canyons. In many incidences, this value then converted to a topographic shading factor of 35%. This input value was entered for both the west and east sides of the water bodies. For two streams that do not have steep canyons, the value was set at 10^o (0.175 radians). This value was determined from USGS 7.5 minute topographic maps.

Vegetation Height: Most of the riparian woody vegetation associated with riparian areas in the Upper Owyhee Watershed is of willows (S*alix sp.*). Some of the willow species that can be encountered include whiplash willow (*S. lasiandra*), sandbar willow (*S. longifollia*), and coyote willow (*S. exigua*). Most of these species are low lying shrubs with a canopy height between 7 and 15 feet. To offset for different species, an input value of 10 feet was set as default for vegetation height. In almost all model runs, vegetation shading calculated to be 0%.

Vegetation Crown: Many of the aspects discussed in vegetation height hold true for the vegetation crown. Most of the woody vegetation in the riparian areas Of the Upper Owyhee Watershed is low-brushy species with multiple shoots creating a dense canopy. To offset for different species encountered, input value of ten (10) feet was set as default for vegetation canopy on both the west and east sides. In almost all model runs, vegetation shading was calculated at zero percent (0%).

Vegetation Offset: Vegetation offset is the distance from the center of the water body to the main trunk of the vegetation. This input value was set at 20) feet as a default. Little information is available to assist with providing an accurate estimate. In almost all model runs, vegetation shading was calculated to be 0%.

Vegetation Density: Bartholow (1999) suggested a dense emergent vegetation cover could have a vegetation density 90%. This value was used as the input for vegetation density. It was shown that this factor had little influence on most streams due to vegetation height, crown and offset.

Stream Network Time of Year:

Time of Year: The value was set at the 15th for June, July and August. This computes an average value for a 30 day model run. This value is most important for determining length of day and sun angle.

Output Values

Stream Segment Intermediate Values:

Day Length: This value is determined by the input for time of year and latitude.

Slope: Calculated from input values for elevation change and stream length

Width: This is the same as the width input value.

Depth: Calculated from segment outflow, gradient and depth.

Vegetation Shade: Total shade minus topographic shade. Vegetation shade may vary based on time of year and azimuth inputs.

Topographic Shade: The model calculates this from input for latitude, time of year, azimuth, and topographic attitude.

Stream Segment Mean Heat Flux (Inflow or Outflow):

Convection: Convection component heat flux gain or loss at inflow or at outflow.

Atmosphere: Atmosphere component heat flux gain.

Conduction: Conduction component heat flux gain or loss at inflow or outflow.

Friction: Friction component heat flux gain or loss.

Evaporation: Friction component heat flux gain or loss at inflow or outflow.

Solar: Solar component heat flux gain or loss.

Background Radiation: Background radiation component heat flux gain or loss at inflow or outflow.

Vegetation: Vegetation component heat flux gain or loss.

Net: Net increase or decrease of heat flux from the sum of the above mentioned components.

Stream Segment Model Results-Outflow Temperature:

Predicted Mean Temperature: Model predicted mean daily water temperature in relation to model inputs.

Estimated Maximum Temperature: Model estimated maximum water daily temperature.

Approximate Minimum Temperature: Model approximated minimum daily water temperature (mean temperature - (maximum temperature-mean temperature)).

Mean Equilibrium: Model mean daily water temperature equilibrium if conditions remain the same.

Maximum Equilibrium: Model maximum daily water temperature equilibrium which maximum temperature may approach.

Minimum Equilibrium: Model minimum daily water temperature which minimum temperature may approach (equilibrium mean temperature - (equilibrium maximum temperature - equilibrium mean temperature)).

Model Validation

The model was validated by determining the root mean square error for both the average daily temperatures and the maximum daily temperatures for the months of July and August 2000.

Unfortunately, the available data consisted of only five data points for July and only four data points for August.

The following tables describe the results for validation of the SSTEMP Model and those water temperatures found in water bodies in the Upper Owyhee Watershed. Overall the model has provided a reasonable estimate of predicting current conditions and establishing reasonable guidance for predicting water temperature changes by increasing the amount of shade.

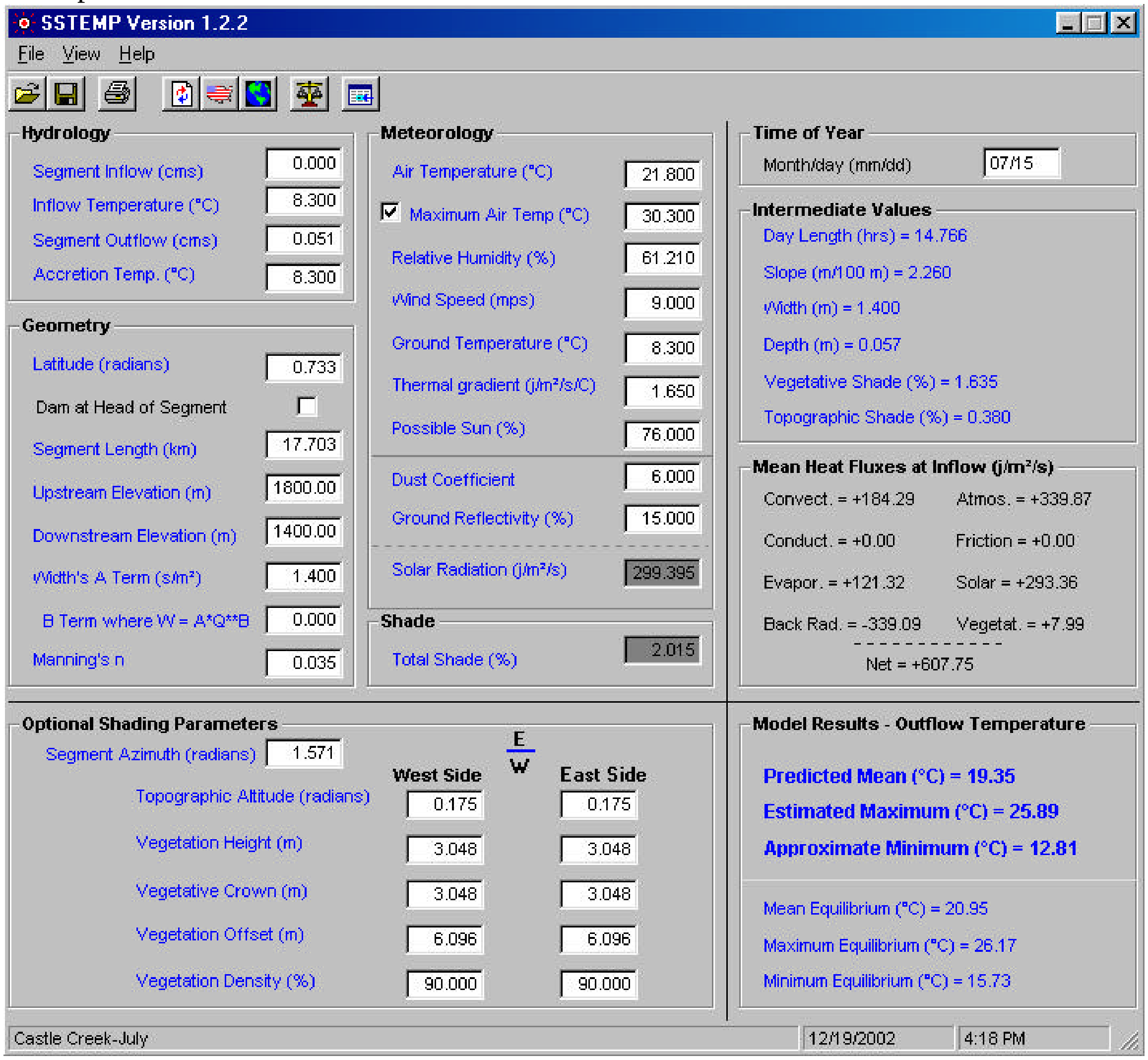
Table D1. Validation Results for July 2000.

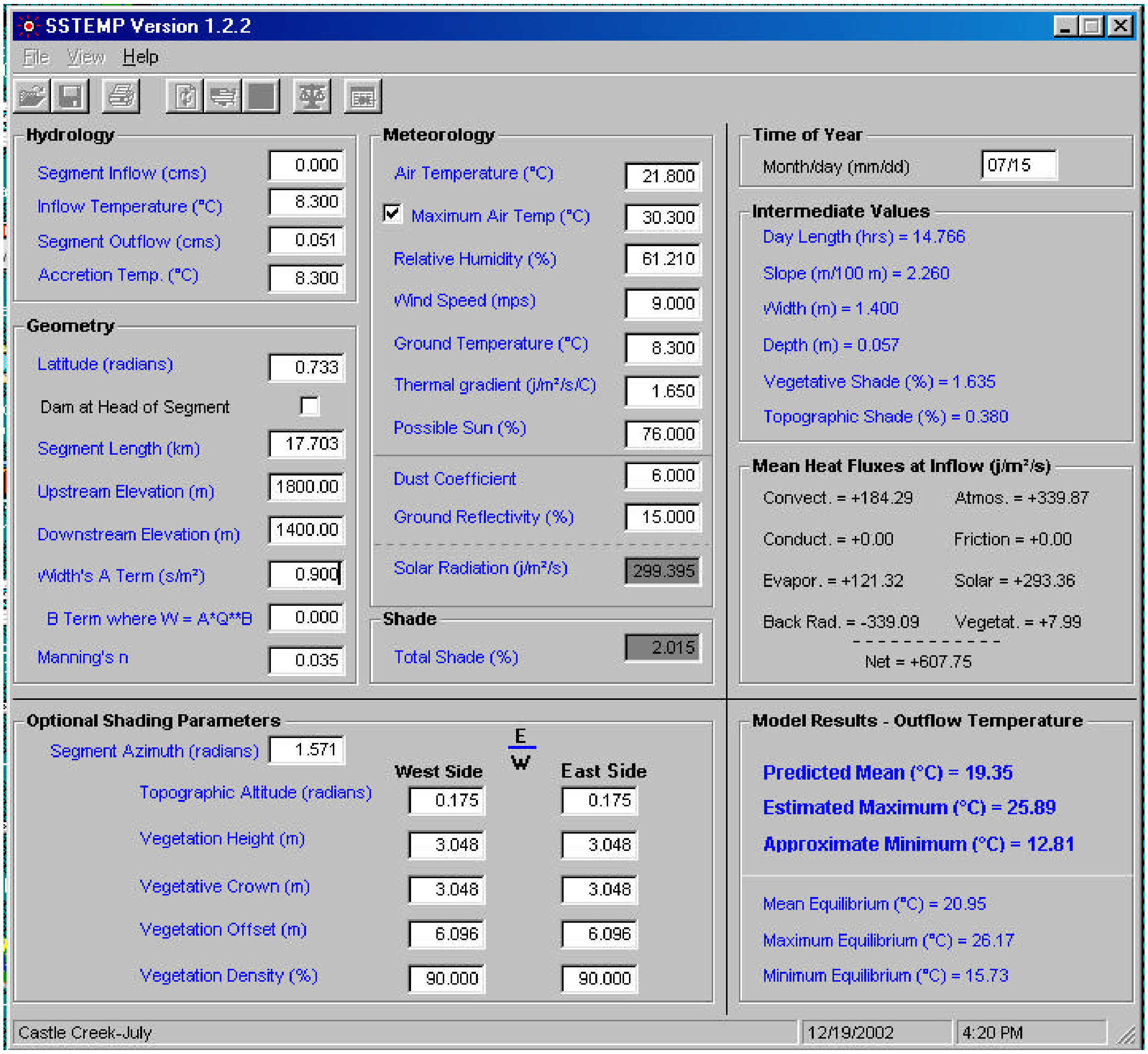
	Actual Measured Daily Average C°	Predicted Daily Average C°	Actual Measured Daily Maximum C°	Predicted Daily Maximum C°
Upper Deep Creek	19.7	19.4	28.1	24.8
Castle Creek	19.7	19.4	28.1	25.9
Upper Pole Creek	19.7	19.2	28.1	25.2
Middle Deep Creek	21.4	19.3	27.9	23.7
Red Canyon Creek	15.8	17.9	19.6	23.8
Average	20.1	19.3	28.1	24.9
		Average	Maximum	
Root Mean Square Error		0.5 °C	1.6°C	
Relative Error		2.6%	5.6%	

Table D2. Validation Results for August 2000.

	Actual Measured Daily Average C°	Predicted Daily Average C°	Actual Measured Daily Maximum C°	Predicted Daily Maximum C°
Upper Deep Creek	17.9	16.5	24.2	24.1
Castle Creek	18.1	17.2	27.7	25.5
Upper Pole Creek	20.1	17.0	24.3	24.7
Middle Deep Creek	21.4	18.2	25.5	23.3
Average	19.4	17.2	25.4	24.4
		Average	Maximum	
Root Mean Square Error		1.8°C	2.3°C	
Relative Error		9.3%	8.9%	

Examples of SSTEMP Model for Castle Creek




SSTEMP Version 1.2.2
File View Help
Hydrology
Segment Inflow (cms) 0.000
Inflow Temperature (°C) 8.300
Segment Outflow (cms) 0.051
Accretion Temp. (°C) 8.300
Geometry
Latitude (radians) 0.733
Dam at Head of Segment
Segment Length (km) 17.703
Upstream Elevation (m) 1800.00
Downstream Elevation (m) 1400.00
Width's A Term (s/m²) 0.900
B Term where W = A*Q**B 0.000
Manning's n 0.035
Meteorology
Air Temperature (°C) 21.800
Maximum Air Temp (°C) 30.300
Relative Humidity (%) 61.210
Wind Speed (mps) 9.000
Ground Temperature (°C) 8.300
Thermal gradient (j/m²/s/C) 1.650
Possible Sun (%) 76.000
Dust Coefficient 6.000
Ground Reflectivity (%) 15.000
Solar Radiation (j/m²/s) 299.395
Shade
Total Shade (%) 2.015
Time of Year
Month/day (mm/dd) 07/15
Intermediate Values
Day Length (hrs) = 14.766
Slope (m/100 m) = 2.260
Width (m) = 1.400
Depth (m) = 0.057
Vegetative Shade (%) = 1.635
Topographic Shade (%) = 0.380
Mean Heat Fluxes at Inflow (j/m²/s)
Convect. = +184.29 Atmos. = +339.87
Conduct. = +0.00 Friction = +0.00
Evapor. = +121.32 Solar = +293.36
Back Rad. = -339.09 Vegetat. = +7.99
Net = +607.75
Optional Shading Parameters
Segment Azimuth (radians) 1.571
E
W
West Side East Side
Topographic Altitude (radians) 0.175 0.175
Vegetation Height (m) 3.048 3.048
Vegetative Crown (m) 3.048 3.048
Vegetation Offset (m) 6.096 6.096
Vegetation Density (%) 90.000 90.000
Model Results - Outflow Temperature
Predicted Mean (°C) = 19.35
Estimated Maximum (°C) = 25.89
Approximate Minimum (°C) = 12.81
Mean Equilibrium (°C) = 20.95
Maximum Equilibrium (°C) = 26.17
Minimum Equilibrium (°C) = 15.73
Castle Creek-July
12/19/2002
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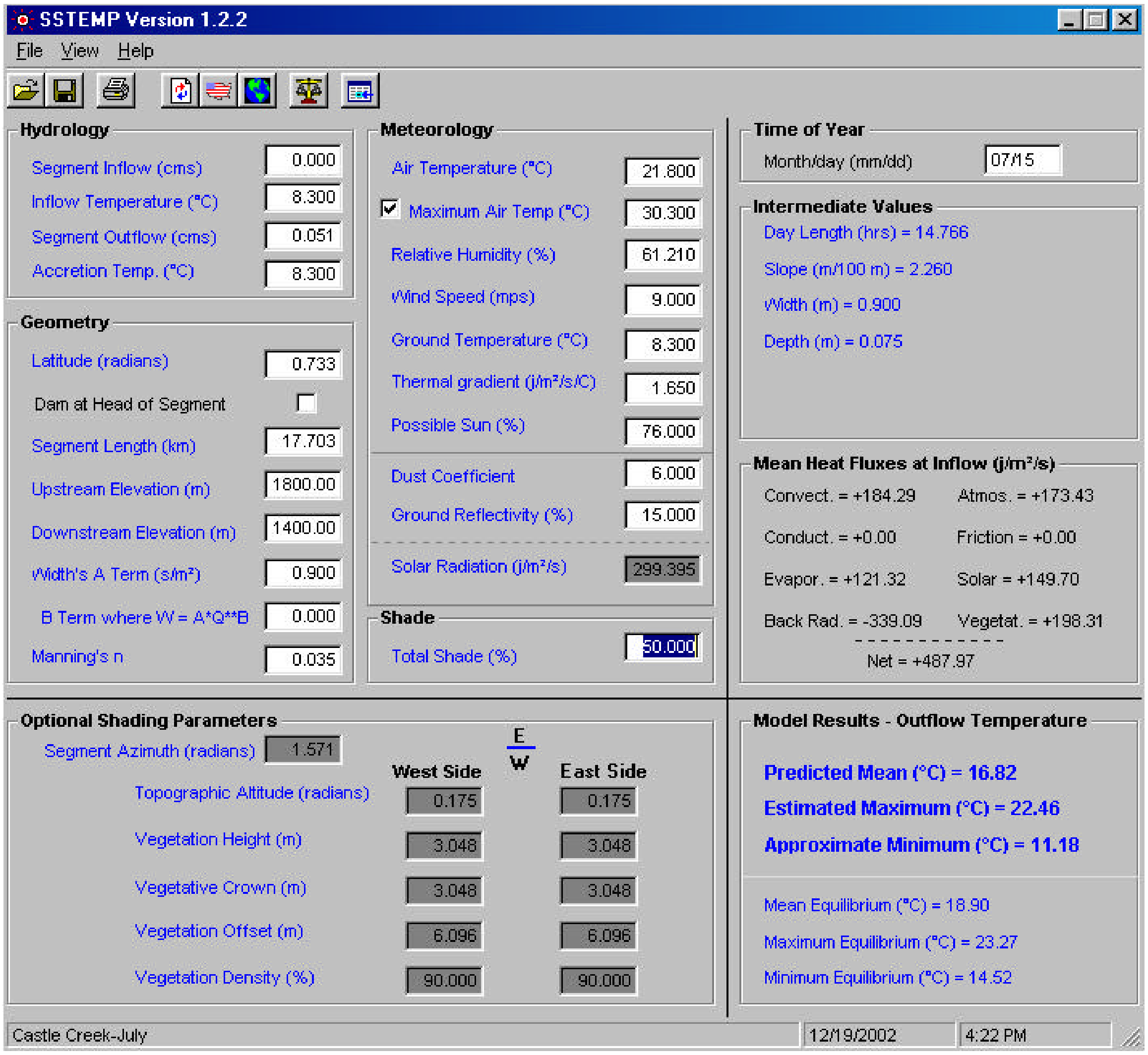
SSTEMP Version 1.2.2
File View Help
Hydrology
Segment Inflow (cms) 0.000
Inflow Temperature (°C) 8.300
Segment Outflow (cms) 0.051
Accretion Temp. (°C) 8.300
Geometry
Latitude (radians) 0.733
Dam at Head of Segment
Segment Length (km) 17.703
Upstream Elevation (m) 1800.00
Downstream Elevation (m) 1400.00
Width's A Term (s/m²) 0.900
B Term where W = A*Q**B 0.000
Manning's n 0.035
Meteorology
Air Temperature (°C) 21.800
Maximum Air Temp (°C) 30.300
Relative Humidity (%) 61.210
Wind Speed (mps) 9.000
Ground Temperature (°C) 8.300
Thermal gradient (j/m²/s/C) 1.650
Possible Sun (%) 76.000
Dust Coefficient 6.000
Ground Reflectivity (%) 15.000
Solar Radiation (j/m²/s) 299.395
Shade
Total Shade (%) 50.000
Time of Year
Month/day (mm/dd) 07/15
Intermediate Values
Day Length (hrs) = 14.766
Slope (m/100 m) = 2.260
Width (m) = 0.900
Depth (m) = 0.075
Mean Heat Fluxes at Inflow (j/m²/s)
Convect. = +184.29 Atmos. = +173.43
Conduct. = +0.00 Friction = +0.00
Evapor. = +121.32 Solar = +149.70
Back Rad. = -339.09 Vegetat. = +198.31
Net = +487.97
Optional Shading Parameters
Segment Azimuth (radians) 1.571
E
W
West Side East Side
Topographic Altitude (radians) 0.175 0.175
Vegetation Height (m) 3.048 3.048
Vegetative Crown (m) 3.048 3.048
Vegetation Offset (m) 6.096 6.096
Vegetation Density (%) 90.000 90.000
Model Results - Outflow Temperature
Predicted Mean (°C) = 16.82
Estimated Maximum (°C) = 22.46
Approximate Minimum (°C) = 11.18
Mean Equilibrium (°C) = 18.90
Maximum Equilibrium (°C) = 23.27
Minimum Equilibrium (°C) = 14.52
Castle Creek-July
12/19/2002
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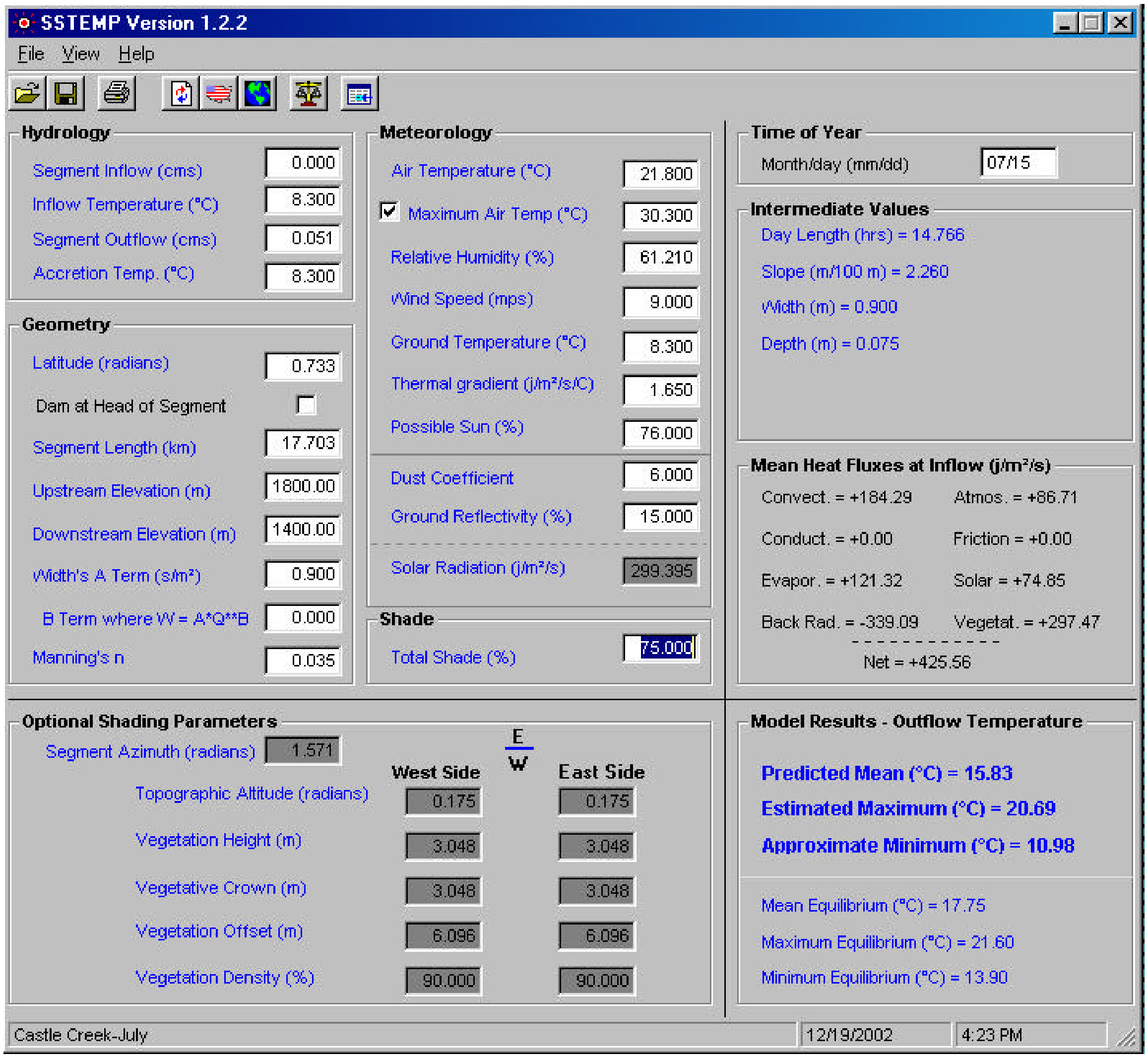
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File View Help
Hydrology
Segment Inflow (cms) 0.000
Inflow Temperature (°C) 8.300
Segment Outflow (cms) 0.051
Accretion Temp. (°C) 8.300
Geometry
Latitude (radians) 0.733
Dam at Head of Segment
Segment Length (km) 17.703
Upstream Elevation (m) 1800.00
Downstream Elevation (m) 1400.00
Width's A Term (s/m²) 0.900
B Term where W = A*Q**B 0.000
Manning's n 0.035
Meteorology
Air Temperature (°C) 21.800
Maximum Air Temp (°C) 30.300
Relative Humidity (%) 61.210
Wind Speed (mps) 9.000
Ground Temperature (°C) 8.300
Thermal gradient (j/m²/s/C) 1.650
Possible Sun (%) 76.000
Dust Coefficient 6.000
Ground Reflectivity (%) 15.000
Solar Radiation (j/m²/s) 299.395
Shade
Total Shade (%) 75.000
Time of Year
Month/day (mm/dd) 07/15
Intermediate Values
Day Length (hrs) = 14.766
Slope (m/100 m) = 2.260
Width (m) = 0.900
Depth (m) = 0.075
Mean Heat Fluxes at Inflow (j/m²/s)
Convect. = +184.29
Atmos. = +86.71
Conduct. = +0.00
Friction = +0.00
Evapor. = +121.32
Solar = +74.85
Back Rad. = -339.09
Vegetat. = +297.47
Net = +425.56
Optional Shading Parameters
Segment Azimuth (radians) 1.571
E
W
West Side
East Side
Topographic Altitude (radians) 0.175 0.175
Vegetation Height (m) 3.048 3.048
Vegetative Crown (m) 3.048 3.048
Vegetation Offset (m) 6.096 6.096
Vegetation Density (%) 90.000 90.000
Model Results - Outflow Temperature
Predicted Mean (°C) = 15.83
Estimated Maximum (°C) = 20.69
Approximate Minimum (°C) = 10.98
Mean Equilibrium (°C) = 17.75
Maximum Equilibrium (°C) = 21.60
Minimum Equilibrium (°C) = 13.90
Castle Creek-July
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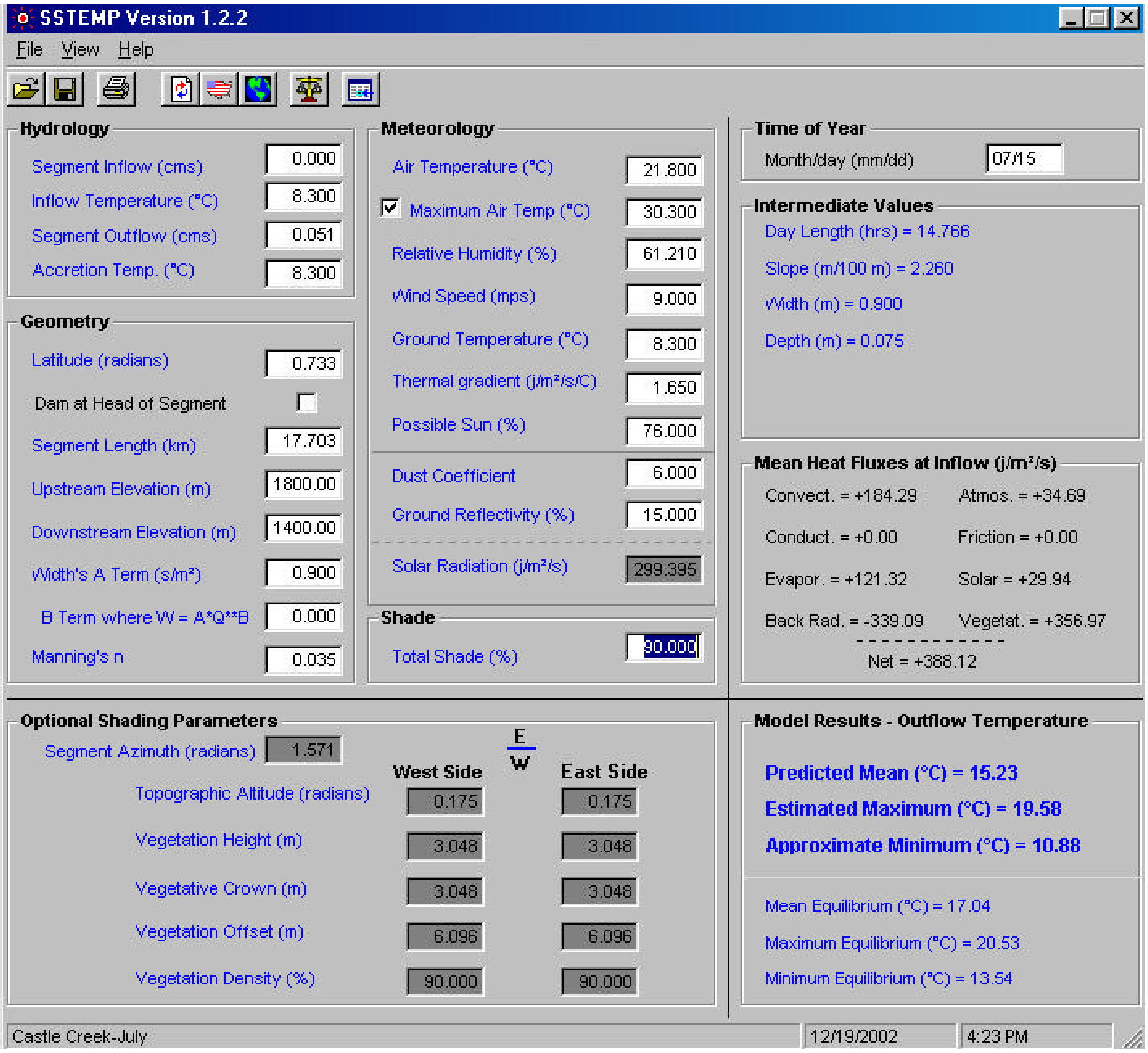
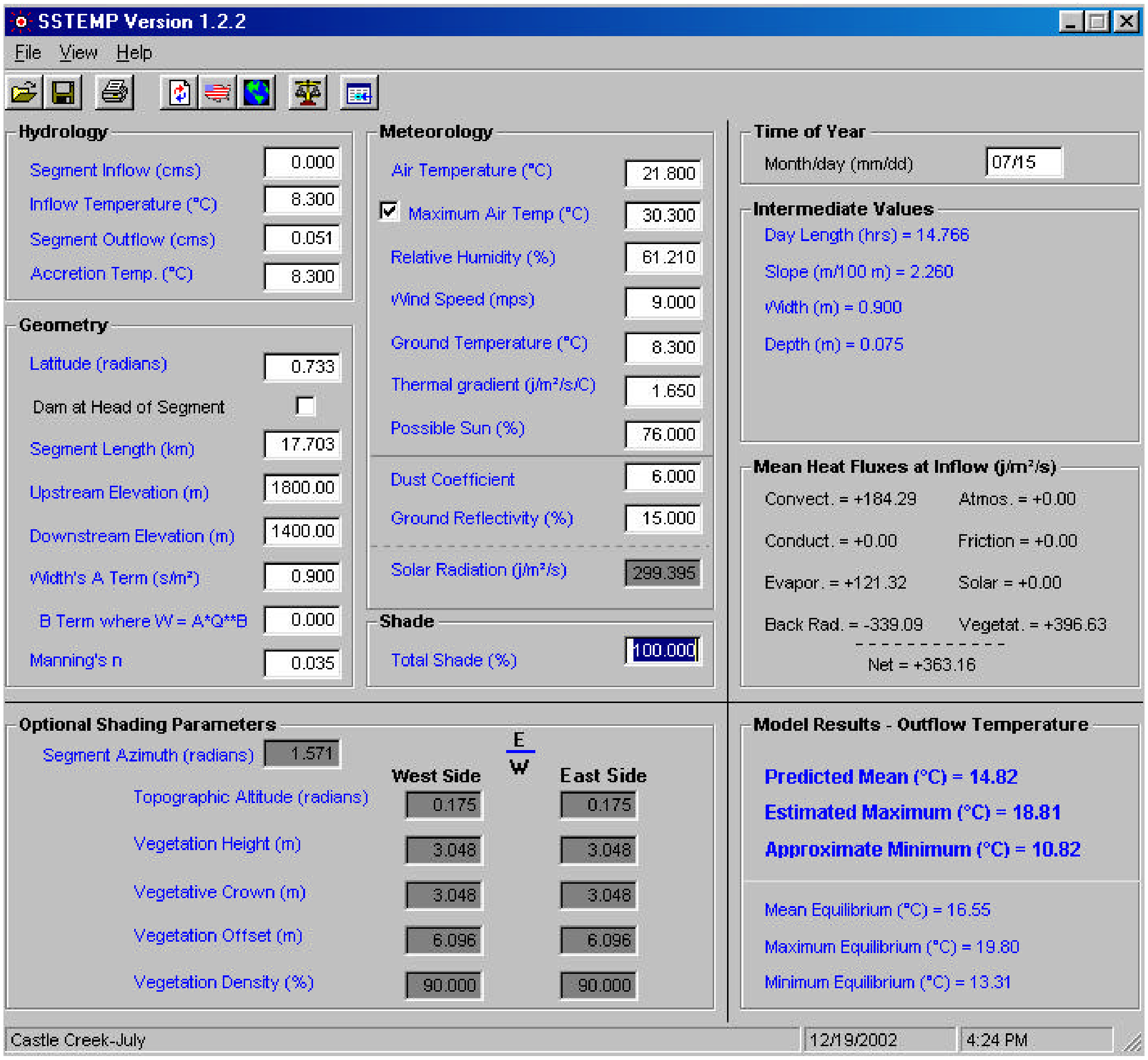

SSTEMP Version 1.2.2
File View Help
Hydrology
Segment Inflow (cms) 0.000
Inflow Temperature (°C) 8.300
Segment Outflow (cms) 0.051
Accretion Temp. (°C) 8.300
Geometry
Latitude (radians) 0.733
Dam at Head of Segment
Segment Length (km) 17.703
Upstream Elevation (m) 1800.00
Downstream Elevation (m) 1400.00
Width's A Term (s/m²) 0.900
B Term where W = A*Q**B 0.000
Manning's n 0.035
Meteorology
Air Temperature (°C) 21.800
Maximum Air Temp (°C) 30.300
Relative Humidity (%) 61.210
Wind Speed (mps) 9.000
Ground Temperature (°C) 8.300
Thermal gradient (j/m²/s/C) 1.650
Possible Sun (%) 76.000
Dust Coefficient 6.000
Ground Reflectivity (%) 15.000
Solar Radiation (j/m²/s) 299.395
Shade
Total Shade (%) 90.000
Time of Year
Month/day (mm/dd) 07/15
Intermediate Values
Day Length (hrs) = 14.766
Slope (m/100 m) = 2.260
Width (m) = 0.900
Depth (m) = 0.075
Mean Heat Fluxes at Inflow (j/m²/s)
Convect. = +184.29 Atmos. = +34.69
Conduct. = +0.00 Friction = +0.00
Evapor. = +121.32 Solar = +29.94
Back Rad. = -339.09 Vegetat. = +356.97
Net = +388.12
Optional Shading Parameters
Segment Azimuth (radians) 1.571
E
W
West Side East Side
Topographic Altitude (radians) 0.175 0.175
Vegetation Height (m) 3.048 3.048
Vegetative Crown (m) 3.048 3.048
Vegetation Offset (m) 6.096 6.096
Vegetation Density (%) 90.000 90.000
Model Results - Outflow Temperature
Predicted Mean (°C) = 15.23
Estimated Maximum (°C) = 19.58
Approximate Minimum (°C) = 10.88
Mean Equilibrium (°C) = 17.04
Maximum Equilibrium (°C) = 20.53
Minimum Equilibrium (°C) = 13.54
Castle Creek-July 12/19/2002 4:23 PM


SSTEMP Version 1.2.2
File View Help
Hydrology
Segment Inflow (cms) 0.000
Inflow Temperature (°C) 8.300
Segment Outflow (cms) 0.051
Accretion Temp. (°C) 8.300
Geometry
Latitude (radians) 0.733
Dam at Head of Segment
Segment Length (km) 17.703
Upstream Elevation (m) 1800.00
Downstream Elevation (m) 1400.00
Width's A Term (s/m²) 0.900
B Term where W = A*Q**B 0.000
Manning's n 0.035
Meteorology
Air Temperature (°C) 21.800
Maximum Air Temp (°C) 30.300
Relative Humidity (%) 61.210
Wind Speed (mps) 9.000
Ground Temperature (°C) 8.300
Thermal gradient (j/m²/s/C) 1.650
Possible Sun (%) 76.000
Dust Coefficient 6.000
Ground Reflectivity (%) 15.000
Solar Radiation (j/m²/s) 299.395
Shade
Total Shade (%) 100.000
Time of Year
Month/day (mm/dd) 07/15
Intermediate Values
Day Length (hrs) = 14.766
Slope (m/100 m) = 2.260
Width (m) = 0.900
Depth (m) = 0.075
Mean Heat Fluxes at Inflow (j/m²/s)
Convect. = +184.29 Atmos. = +0.00
Conduct. = +0.00 Friction = +0.00
Evapor. = +121.32 Solar = +0.00
Back Rad. = -339.09 Vegetat. = +396.63
Net = +363.16
Optional Shading Parameters
Segment Azimuth (radians) 1.571
E
W
West Side East Side
Topographic Altitude (radians) 0.175 0.175
Vegetation Height (m) 3.048 3.048
Vegetative Crown (m) 3.048 3.048
Vegetation Offset (m) 6.096 6.096
Vegetation Density (%) 90.000 90.000
Model Results - Outflow Temperature
Predicted Mean (°C) = 14.82
Estimated Maximum (°C) = 18.81
Approximate Minimum (°C) = 10.82
Mean Equilibrium (°C) = 16.55
Maximum Equilibrium (°C) = 19.80
Minimum Equilibrium (°C) = 13.31
Castle Creek-July
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4:24 PM

SSTEMP (1.2.2) Sensitivity Analysis

Sensitivity for mean temperature values (10% variation) SSTEMP (1.2.2)
Original mean temperature = 14.82°C

Variable	Temperature change (°C) if variable is: Decreased	Increased	Relative Sensitivity
Segment Inflow (cms)	+0.00	+0.00	
Inflow Temperature (°C)	0.00	+0.00	
Segment Outflow (cms)	+0.13	-0.14	**
Accretion Temp. (°C)	-0.17	+0.17	***
Width's A Term (s/m²)	-0.13	+0.15	***
B Term where W = A*Q**B	+0.00	+0.00	
Manning's n	+0.00	+0.00	
Air Temperature (°C)	-1.64	+1.58	*******************************
Relative Humidity (%)	-0.68	+0.69	*************
Wind Speed (mps)	-0.08	+0.09	**
Ground Temperature (°C)	-0.02	+0.02	
Thermal gradient (j/m²/s/C)	+0.02	-0.02	
Possible Sun (%)	+0.00	+0.00	
Dust Coefficient	+0.00	+0.00	
Ground Reflectivity (%)	+0.00	+0.00	
Total Shade (%)	+0.00	-0.41	*******
Maximum Air Temp (°C)	+0.00	+0.00	

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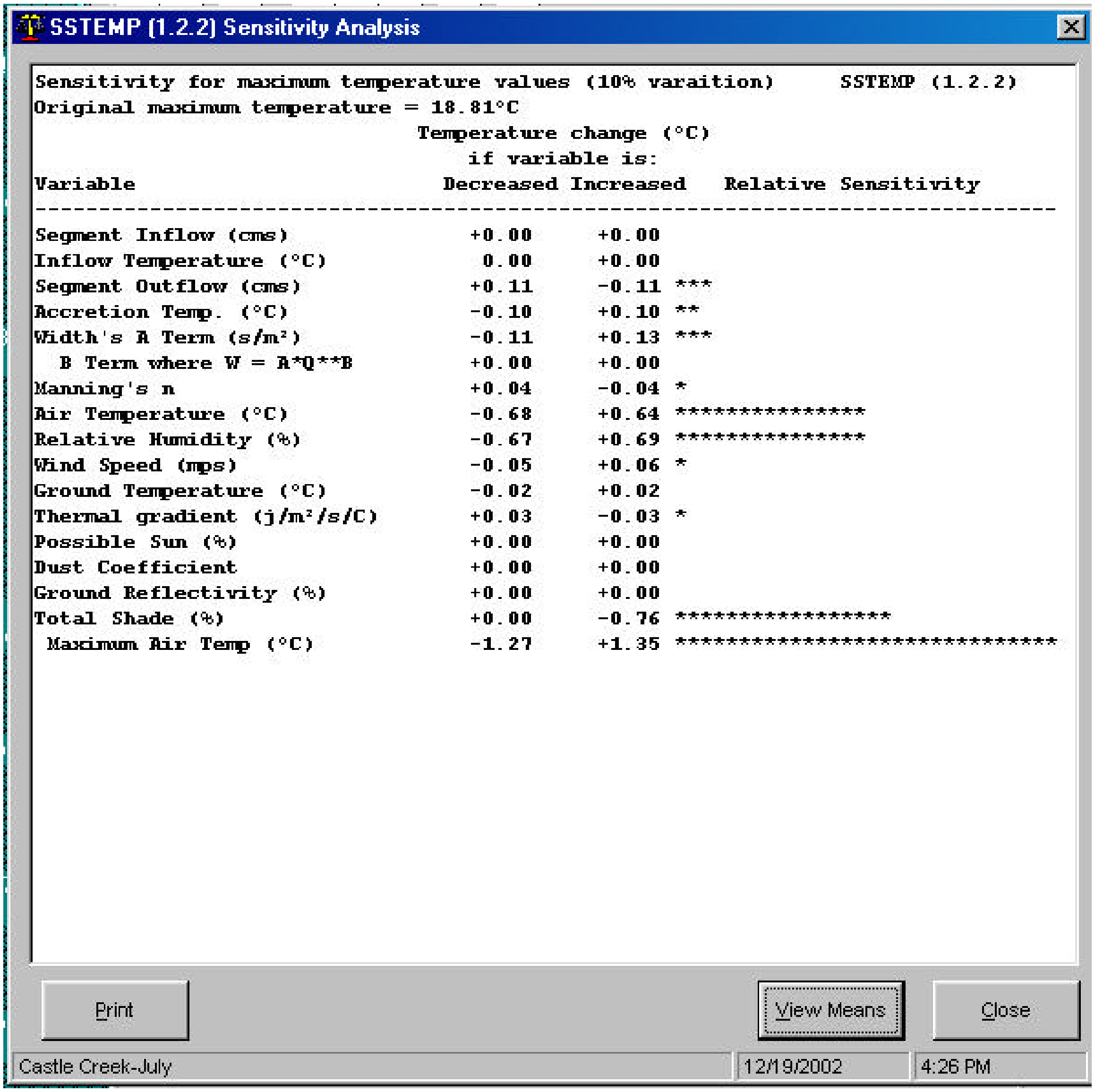

Sensitivity for maximum temperature values (10% varaition) SSTEMP (1.2.2)
Original maximum temperature = 18.81°C

Variable	Temperature change (°C) if variable is: Decreased	Increased	Relative Sensitivity
Segment Inflow (cms)	+0.00	+0.00	
Inflow Temperature (°C)	0.00	+0.00	
Segment Outflow (cms)	+0.11	-0.11	***
Accretion Temp. (°C)	-0.10	+0.10	**
Width's A Term (s/m²)	-0.11	+0.13	***
B Term where W = A*Q**B	+0.00	+0.00	
Manning's n	+0.04	-0.04	*
Air Temperature (°C)	-0.68	+0.64	***************
Relative Humidity (%)	-0.67	+0.69	***************
Wind Speed (mps)	-0.05	+0.06	*
Ground Temperature (°C)	-0.02	+0.02	
Thermal gradient (j/m²/s/C)	+0.03	-0.03	*
Possible Sun (%)	+0.00	+0.00	
Dust Coefficient	+0.00	+0.00	
Ground Reflectivity (%)	+0.00	+0.00	
Total Shade (%)	+0.00	-0.76	*****************
Maximum Air Temp (°C)	-1.27	+1.35	******************************

Table D3.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Mid-Pole-Cowboy Creeks to Deep Creek F	13°C Max 9°C Avg.	June 1 through June 30	8.2	+122.43	34.4	34.4	0.0	32.1	Minimum Mean Maximum	10.7 14.4 18.1
				+126.77	34.4	34.4	0.0	11.8	Minimum Mean Maximum	9.8 13.5 17.3
				+88.84	50.0	34.4	15.4	11.8	Minimum Mean Maximum	9.8 13.0 16.1
				+22.64	75.0	34.4	35.6	11.8	Minimum Mean Maximum	10.0 12.1 14.1
				-15.89	90.0	34.4	55.6	11.8	Minimum Mean Maximum	10.0 11.5 12.9
				-41.57	100.0	34.4	65.6	11.8	Minimum Mean Maximum	10.1 11.1 12.1
Bull Gulch B, G and F	13°C Max 9°C Avg.	June 1 through June 30	14.5	+402.09	7.7	0.9	6.8	24.4	Minimum Mean Maximum	11.7 16.2 20.1
				+416.55	2.3	0.4	1.9	10.9	Minimum Mean Maximum	10.9 15.9 20.9
				+293.98	50.0	0.4	49.6	10.9	Minimum Mean Maximum	10.6 13.8 17.1
				+229.73	75.0	0.4	74.6	10.9	Minimum Mean Maximum	10.5 12.7 14.9
				+191.18	90.0	0.4	89.6	10.9	Minimum Mean Maximum	10.5 12.0 13.5
				+165.48	100	0.4	99.6	10.9	Minimum Mean Maximum	10.4 11.5 12.6

Table D4.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	^oC
Red Canyon Creek A, B and F	13^{o}C Max 9^{o}C Avg.	June 1 through June 30	13.2	+360.52	23.7	20.8	2.9	25.4	Minimum Mean Maximum	8.6 13.1 17.6
				+358.32	24.6	20.8	3.8	11.8	Minimum Mean Maximum	7.8 12.1 16.4
				+292.97	50.0	20.8	29.2	11.8	Minimum Mean Maximum	8.2 11.4 14.7
				+228.64	75.0	20.8	54.2	11.8	Minimum Mean Maximum	8.6 10.7 12.8
				+190.05	90.0	20.8	69.2	11.8	Minimum Mean Maximum	8.9 10.3 11.7
				+164.32	100.0	20.8	79.2	11.8	Minimum Mean Maximum	9.1 10.0 11.0
Lower Deep Creek F	13^{o}C Max 9^{o}C Avg.	June 1 through June 30	8.4	+129.12	34.4	34.4	0.0	104.0	Minimum Mean Maximum	13.0 15.7 18.4
				+89.3	50.0	34.4	15.6	104.0	Minimum Mean Maximum	12.7 14.9 17.2
				+25.31	75.0	34.4	40.6	104.0	Minimum Mean Maximum	12.1 13.7 15.2
				-13.11	90.0	34.4	55.6	104.0	Minimum Mean Maximum	11.8 12.9 14.0
				-38.72	100.0	34.4	65.6	104.0	Minimum Mean Maximum	11.6 12.4 13.1

Table D5.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Upper Dickshooter Creek G, F	13°C Max 9°C Avg.	June 1 through June 30	11.7	+277.12	2.3	0.4	1.9	30.3	Minimum Mean Maximum	10.5 14.8 19.1
				+279.06	2.3	0.4	1.9	13.3	Minimum Mean Maximum	10.5 14.8 19.2
				+156.69	50.0	0.4	49.6	13.3	Minimum Mean Maximum	9.2 12.2 15.1
				+92.54	75.0	0.4	74.6	13.3	Minimum Mean Maximum	8.6 10.6 12.7
				+54.05	90.0	0.4	89.6	13.3	Minimum Mean Maximum	8.2 9.7 11.1
				+28.39	100.0	0.4	99.6	13.3	Minimum Mean Maximum	8.0 9.0 10.0
Lower Dickshooter Creek F	13°C Max 9°C Avg.	June 1 through June 30	13.0	+53.93	33.6	33.6	0.0	22.8	Minimum Mean Maximum	7.1 12.4 17.6
				+54.56	33.6	33.6	0.0	11.9	Minimum Mean Maximum	6.7 11.7 16.7
				+12.46	50.0	33.6	16.4	11.9	Minimum Mean Maximum	7.0 11.0 14.9
				-51.76	75.0	33.6	38.4	11.9	Minimum Mean Maximum	7.5 9.8 12.2
				-90.28	90.0	33.6	53.4	11.9	Minimum Mean Maximum	7.7 10.6 9.2
				-115.97	100.0	33.6	66.4	11.9	Minimum Mean Maximum	7.9 8.7 9.6

Table D6.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	^{o}C
Beaver Creek A, B & G	13^{o}C Max 9^{o}C Avg.	June 1 through June 30	8.7	+273.40	2.6	0.9	1.7	24.2	Minimum Mean Maximum	7.8 13.1 18.3
				+273.36	2.6	0.9	1.7	11.4	Minimum Mean Maximum	7.1 12.4 17.8
				+151.68	50.0	0.9	49.1	11.4	Minimum Mean Maximum	7.3 10.6 13.9
				+87.51	75.0	0.9	74.1	11.4	Minimum Mean Maximum	7.5 9.6 11.8
				+49.00	90.0	0.9	89.1	11.4	Minimum Mean Maximum	7.6 9.1 10.5
				+23.33	100.0	0.9	99.1	11.4	Minimum Mean Maximum	7.7 8.7 9.7

Table D7.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Mid-Pole-Cowboy Creeks to Deep Creek F	13°C Max 9°C Avg.	June 1 through June 30	8.2	+141.67	34.4	34.4	0.0	27.6	Minimum Mean Maximum	8.7 12.3 16.0
				+144.85	34.4	34.4	0.0	11.6	Minimum Mean Maximum	8.4 11.9 15.5
				+104.96	50.0	34.4	15.6	11.6	Minimum Mean Maximum	8.3 11.2 14.2
				+40.87	75.0	34.4	40.6	11.6	Minimum Mean Maximum	8.2 10.1 12.1
				+2.42	90.0	34.4	55.6	11.6	Minimum Mean Maximum	8.1 9.4 10.8
				-23.22	100.0	34.4	65.6	11.6	Minimum Mean Maximum	8.1 9.0 9.9
Bull Gulch B, G and F	13°C Max 9°C Avg.	June 1 through June 30	14.5	+191.66	34.4	34.4	0.0	24.3	Minimum Mean Maximum	8.5 12.3 16.2
				+191.66	34.4	34.4	0.0	14.0	Minimum Mean Maximum	8.2 12.1 16.0
				+151.71	50.0	34.4	15.6	14.0	Minimum Mean Maximum	8.1 11.3 14.6
				+87.54	75.0	34.4	40.6	14.0	Minimum Mean Maximum	7.9 10.1 12.3
				+49.04	90.0	34.4	55.6	14.0	Minimum Mean Maximum	7.8 9.3 10.8
				+23.37	100.0	34.4	65.6	14.0	Minimum Mean Maximum	7.8 8.8 9.8

Table D8.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m²/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Mid-Pole Creek to Deep Creek F	13°C Max 9°C Avg.	June 1 through June 30	10.3	+195.36	14.5	11.2	3.3	28.1	Minimum Mean Maximum	10.1 14.1 18.1
				+195.84	16.1	11.2	4.8	12.7	Minimum Mean Maximum	9.8 13.8 17.8
				+108.82	50.0	11.2	38.8	12.7	Minimum Mean Maximum	9.2 12.0 14.9
				+44.73	75.0	11.2	63.8	11.7	Minimum Mean Maximum	8.7 10.7 12.6
				+6.28	90.0	11.2	78.8	11.7	Minimum Mean Maximum	8.5 9.8 11.2
				-19.36	100.0	11.2	88.8	11.7	Minimum Mean Maximum	8.4 9.3 10.2
Castle Creek A, B, C and G	13°C Max 9°C Avg.	June 1 through June 30	11.0	+274.04	2.4	1.4	1.0	25.4	Minimum Mean Maximum	8.0 13.1 18.2
				+272.50	2.6	1.4	1.2	12.9	Minimum Mean Maximum	7.4 12.5 17.6
				+151.83	50.0	1.4	48.6	12.9	Minimum Mean Maximum	7.5 10.7 13.8
				+87.68	75.0	1.4	73.6	12.9	Minimum Mean Maximum	7.6 9.7 11.7
				+49.19	90.0	1.4	88.6	12.9	Minimum Mean Maximum	7.7 9.1 10.5
				+23.53	100.0	1.4	98.6	12.9	Minimum Mean Maximum	7.7 8.7 9.6

Table D9.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Hurry Back A, B and C	13°C Max 9°C Avg.	June 1 through June 30	11.2	+246.21	12.6	7.1	5.5	28.4	Minimum Mean Maximum	7.5 12.2 16.9
				+241.25	14.5	7.1	7.4	12.2	Minimum Mean Maximum	7.0 11.4 15.8
				+150.16	50.0	7.1	42.9	12.2	Minimum Mean Maximum	7.3 10.2 13.2
				+85.90	75.0	7.1	67.9	12.2	Minimum Mean Maximum	7.5 9.4 11.3
				+47.35	90.0	7.1	82.1	12.2	Minimum Mean Maximum	7.6 8.9 10.2
				+21.64	100.0	7.1	92.1	12.2	Minimum Mean Maximum	7.7 8.6 9.5
Nip and Tuck Creek A, B and C	13°C Max 9°C Avg.	June 1 through June 30	6.8	+242.46	14.1	7.1	7.0	22.9	Minimum Mean Maximum	6.5 11.5 16.5
				+239.20	15.4	7.1	8.3	11.8	Minimum Mean Maximum	6.0 10.8 15.7
				+150.23	50.0	7.1	42.9	11.8	Minimum Mean Maximum	6.7 9.9 13.1
				+85.89	75.0	7.1	67.9	11.8	Minimum Mean Maximum	7.2 9.2 11.3
				+47.42	90.0	7.1	82.9	11.8	Minimum Mean Maximum	7.4 8.8 10.2
				+21.72	100.0	7.1	92.9	11.8	Minimum Mean Maximum	7.6 8.5 9.5

Table D10.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Deep Creek to Current Cr. F	13°C Max 9°C Avg.	June 1 through June 30	5	+147.99	34.4	34.4	0.0	22.9	Minimum Mean Maximum	8.2 11.0 13.7
				+149.59	34.4	34.4	0.0	12.9	Minimum Mean Maximum	8.2 10.6 13.1
				+109.77	50.0	34.4	15.6	12.9	Minimum Mean Maximum	8.3 10.3 12.3
				+45.69	75.0	34.4	40.6	12.9	Minimum Mean Maximum	8.6 9.9 11.1
				+7.24	90.0	34.4	55.6	`12.9	Minimum Mean Maximum	8.7 9.6 10.4
				-18.40	100.0	34.4	65.6	12.9	Minimum Mean Maximum	8.8 9.4 9.9
Current Creek A, B and C	13°C Max 9°C Avg.	June 1 through June 30	13.5	+191.13	34.4	34.4	0.0	25.8	Minimum Mean Maximum	7.7 11.3 14.9
				+191.13	34.4	34.4	0.0	11.8	Minimum Mean Maximum	7.4 10.8 14.2
				+151.13	50.0	34.4	15.6	11.8	Minimum Mean Maximum	7.5 10.3 13.1
				+86.88	75.0	34.4	40.6	11.8	Minimum Mean Maximum	7.7 9.4 11.2
				+48.32	90.0	34.4	55.6	11.8	Minimum Mean Maximum	7.7 8.9 10.1
				+22.62	100.0	34.4	65.6	11.8	Minimum Mean Maximum	7.8 8.6 9.4

Table D11.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	^oC
Red Canyon Creek A, B and F	13^{o}C Max 9^{o}C Avg.	June 1 through June 30	13.2	+191.21	34.4	34.4	0.0	24.2	Minimum Mean Maximum	7.7 11.5 15.3
				+191.21	34.4	34.4	0.0	14.9	Minimum Mean Maximum	7.4 11.2 15.0
				+151.22	50.0	34.4	15.6	14.9	Minimum Mean Maximum	7.5 10.6 13.7
				+86.89	75.0	34.4	40.6	14.9	Minimum Mean Maximum	7.6 9.6 11.7
				+48.44	90.0	34.4	55.6	14.9	Minimum Mean Maximum	7.7 9.0 10.4
				+22.74	100.0	34.4	65.6	14.9	Minimum Mean Maximum	7.7 8.7 9.6
Lower Deep Creek F	13^{o}C Max 9^{o}C Avg.	June 1 through June 30	8.4	+148.57	34.4	34.4	0.0	100	Minimum Mean Maximum	8.8 11.9 15.0
				+108.76	50.0	34.4	15.6	100	Minimum Mean Maximum	8.7 11.2 13.8
				+44.80	75.0	34.4	40.6	100	Minimum Mean Maximum	8.5 10.1 11.8
				+6.42	90.0	34.4	55.6	100	Minimum Mean Maximum	8.3 9.5 10.6
				-19.16	100.0	34.4	65.6	100	Minimum Mean Maximum	8.2 9.0 9.8

Table D12.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m²/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Middle Deep Creek Nickel Cr. To Pole Creek F	13°C Max 9°C Avg.	June 1 through June 30	5	+159.46	34.4	34.4	0.0	27.0	Minimum Mean Maximum	7.8 10.6 13.4
				+162.95	34.4	34.4	0.0	12.8	Minimum Mean Maximum	7.7 10.2 12.6
				+123.10	50.0	34.4	15.6	12.8	Minimum Mean Maximum	8.0 9.9 11.9
				+59.09	75.0	34.4	55.6	12.8	Minimum Mean Maximum	8.3 9.6 10.8
				+20.69	90.0	34.4	65.6	12.8	Minimum Mean Maximum	8.5 9.3 10.1
				-4.92	100.0	34.4	75.6	12.8	Minimum Mean Maximum	8.6 9.2 9.7
Nickel Creek A, B, C and F	13°C Max 9°C Avg.	June 1 through June 30	9.7	+190.91	34.4	34.4	0.0	29.1	Minimum Mean Maximum	7.3 11.3 15.3
				+190.91	34.4	34.4	0.0	11.5	Minimum Mean Maximum	6.8 10.6 14.5
				+150.89	50.0	34.4	15.6	11.5	Minimum Mean Maximum	7.0 10.1 13.3
				+86.60	75.0	34.4	40.6	11.5	Minimum Mean Maximum	7.3 9.4 11.4
				+48.02	90.0	34.4	55.6	11.5	Minimum Mean Maximum	7.5 8.9 10.3
				+22.31	100.0	34.4	65.6	11.5	Minimum Mean Maximum	7.7 8.6 9.5

Table D13.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Middle Deep, Current Creek to Nickel Creek F	13°C Max 9°C Avg.	June 1 through June 30	15.8	+162.92	34.4	34.4	0.0	24.9	Minimum Mean Maximum	9.4 12.1 14.8
				+166.17	34.4	34.4	0.0	13.0	Minimum Mean Maximum	9.2 11.6 14.0
				+126.39	50.0	34.4	15.6	13.0	Minimum Mean Maximum	9.0 11.0 13.0
				+62.36	75.0	34.4	40.6	13.0	Minimum Mean Maximum	8.8 10.1 11.4
				+23.94	90.0	34.4	55.6	13.0	Minimum Mean Maximum	8.6 9.5 10.4
				-1.67	100.0	34.4	65.6	13.0	Minimum Mean Maximum	8.5 9.1 9.7
Upper Pole Creek A, B, C and F	13°C Max 9°C Avg.	June 1 through June 30	6.8	+241.67	14.7	1.7	13.0	22.4	Minimum Mean Maximum	8.5 13.1 17.6
				+238.59	15.9	1.7	14.2	11.5	Minimum Mean Maximum	8.1 12.6 17.2
				+150.83	50.0	1.7	48.3	11.5	Minimum Mean Maximum	7.9 11.1 14.2
				+86.53	75.0	1.7	73.3	11.5	Minimum Mean Maximum	7.8 9.9 12.0
				+47.95	90.0	1.7	88.3	11.5	Minimum Mean Maximum	7.8 9.2 10.6
				+22.24	100.0	1.7	98.3	11.5	Minimum Mean Maximum	7.8 8.7 9.7

Table D14.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Nip and Tuck A, B and G	22°C Max 19°C Avg.	Ju1y 1 through July 31	6.8	+568.79	16.1	11.5	4.6	25.4	Minimum Mean Maximum	10.4 17.6 24.7
				+566.01	17.2	11.5	5.7	13.3	Minimum Mean Maximum	9.0 16.6 24.1
				+483.94	50.0	11.5	38.5	13.3	Minimum Mean Maximum	9.0 15.4 21.9
				+421.43	75.0	11.5	63.5	13.3	Minimum Mean Maximum	9.1 14.6 20.1
				+383.92	90.0	11.5	73.5	13.3	Minimum Mean Maximum	9.2 14.0 18.9
				+358.92	100.0	11.5	88.5	13.3	Minimum Mean Maximum	9.2 13.7 18.1
Current-Stoneman Creeks A, B, C and F	22°C Max 19°C Avg.	July 1 through July 31	8.9	+523.40	34.9	34.9	0.0	25.3	Minimum Mean Maximum	12.0 17.8 23.5
				+523.40	34.9	34.9	0.0	14.2	Minimum Mean Maximum	11.2 17.2 23.1
				+485.58	50.0	34.9	15.1	14.2	Minimum Mean Maximum	11.1 16.7 22.1
				+423.07	75.0	34.9	40.1	14.2	Minimum Mean Maximum	10.9 15.6 20.3
				+385.56	90.0	34.9	55.1	14.2	Minimum Mean Maximum	10.8 15.0 19.2
				+360.55	100.0	34.9	65.1	14.2	Minimum Mean Maximum	10.8 14.6 18.5

Table D15.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Nickel Creek A, B, G and F	22°C Max 19°C Avg.	Ju1y 1 through July 31	9.7	+520.37	34.9	34.9	0.0	23.3	Minimum Mean Maximum	11.0 17.3 23.6
				+520.37	34.9	34.9	0.0	13.7	Minimum Mean Maximum	10.2 16.7 23.2
				+482.53	50.0	34.9	15.1	13.7	Minimum Mean Maximum	10.1 16.1 22.2
				+419.98	75.0	34.9	40.1	13.7	Minimum Mean Maximum	10.0 15.2 20.4
				+382.45	90.0	34.9	55.1	13.7	Minimum Mean Maximum	10.0 14.6 19.3
				+357.43	100.0	34.9	65.1	13.7	Minimum Mean Maximum	10.0 14.2 18.5
Upper Pole Creek B, C and G	22°C Max 19°C Avg.	July 1 through July 31	6.8	+566.77	16.3	1.8	14.5	26.0	Minimum Mean Maximum	13.2 19.2 25.2
				+564.48	17.2	1.8	15.4	11.9	Minimum Mean Maximum	12.3 18.6 24.8
				+482.33	50.0	1.8	48.2	11.9	Minimum Mean Maximum	11.8 17.2 22.7
				+419.78	75.0	1.8	73.2	11.9	Minimum Mean Maximum	11.5 16.2 20.9
				+382.25	90.0	1.8	88.2	11.9	Minimum Mean Maximum	11.4 15.6 19.8
				+357.22	100.0	1.8	98.2	11.9	Minimum Mean Maximum	11.3 15.1 19.0

Table D16.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Camas Creek B, C and G	22°C Max 19°C Avg.	Ju1y 1 through July 31	8.9	+588.57	8.5	0.9	7.6	26.0	Minimum Mean Maximum	13.4 19.6 25.8
				+587.65	8.9	0.9	8.0	15.1	Minimum Mean Maximum	12.7 19.2 25.7
				+484.87	50.0	0.9	49.9	15.1	Minimum Mean Maximum	12.0 17.6 23.1
				+422.33	75.0	0.9	74.1	15.1	Minimum Mean Maximum	11.7 16.5 21.4
				+384.80	90.0	0.9	89.1	15.1	Minimum Mean Maximum	11.5 15.9 20.2
				+359.76	100.0	0.9	99.1	15.1	Minimum Mean Maximum	11.4 15.4 19.5
Camel Creek A, B, C and G	22°C Max 19°C Avg.	July 1 through July 31		+567.07	16.6	7.3	9.3	24.3	Minimum Mean Maximum	13.9 19.5 25.2
				+565.91	17.1	7.3	9.8	12.3	Minimum Mean Maximum	13.3 19.2 25.1
				+483.66	50.0	7.3	42.7	12.3	Minimum Mean Maximum	12.7 17.8 22.9
				+421.17	75.0	7.3	64.7	12.3	Minimum Mean Maximum	12.3 16.7 21.2
				+383.67	90.0	7.3	82.7	12.3	Minimum Mean Maximum	12.1 16.1 20.1
				+358.67	100.0	7.3	92.7	12.3	Minimum Mean Maximum	11.9 15.6 19.3

Table D17.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Castle Creek A, B, C and G	22°C Max 19°C Avg.	Ju1y 1 through July 31	11.0	+607.76	2.0	0.4	1.6	24.5	Minimum Mean Maximum	12.8 19.4 25.9
				+607.57	2.1	0.4	1.7	12.0	Minimum Mean Maximum	11.7 18.6 25.5
				+487.97	50.0	0.4	49.6	12.0	Minimum Mean Maximum	11.2 16.8 22.5
				+425.56	75.0	0.4	74.6	12.0	Minimum Mean Maximum	11.0 15.8 20.7
				+388.12	90.0	0.4	89.6	12.0	Minimum Mean Maximum	10.9 15.2 19.6
				+363.16	100.0	0.4	99.6	12.0	Minimum Mean Maximum	10.8 14.8 18.8
Beaver Creek B, C and G	22°C Max 19°C Avg.	July 1 through July 31	8.7	+607.14	2.1	0.4	1.7	26.1	Minimum Mean Maximum	12.6 19.3 26.0
				+607.10	2.1	0.4	1.7	11.1	Minimum Mean Maximum	11.1 18.4 25.6
				+487.45	50.0	0.4	49.6	11.1	Minimum Mean Maximum	10.7 16.6 22.5
				+425.02	75.0	0.4	74.6	11.1	Minimum Mean Maximum	10.5 15.6 20.8
				+387.56	90.0	0.4	89.6	11.1	Minimum Mean Maximum	10.5 15.0 19.6
				+362.59	100.0	0.4	99.6	11.1	Minimum Mean Maximum	10.4 11.6 18.8

Table D18.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m²/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Bull Gulch B and F	22°C Max 19°C Avg.	Ju1y 1 through July 31	14.5	+525.24	34.9	34.9	0.0	23.5	Minimum Mean Maximum	13.1 18.6 24.1
				+525.24	34.9	34.9	0.0	11.1	Minimum Mean Maximum	12.3 18.1 24.0
				+487.55	50.0	34.9	15.1	11.1	Minimum Mean Maximum	12.1 17.5 23.0
				+425.13	75.0	34.9	40.1	11.1	Minimum Mean Maximum	11.7 16.5 21.2
				+387.67	90.0	34.9	55.1	11.1	Minimum Mean Maximum	11.5 15.8 20.1
				+362.70	100.0	34.9	65.1	11.1	Minimum Mean Maximum	11.4 15.4 19.4
Upper Dickshooter Creek B and C	22°C Max 19°C Avg.	July 1 through July 31		+591.40	8.6	3.5	5.0	22.2	Minimum Mean Maximum	14.1 19.9 25.8
				+591.20	8.6	3.5	5.1	13.9	Minimum Mean Maximum	13.8 19.7 25.7
				+487.97	50.0	3.5	46.5	13.9	Minimum Mean Maximum	12.9 18.0 23.1
				+425.56	75.0	3.5	71.5	13.9	Minimum Mean Maximum	12.5 16.9 21.4
				+388.12	90.0	3.5	86.5	13.9	Minimum Mean Maximum	12.3 16.3 20.3
				+363.16	100.0	3.5	96.5	13.9	Minimum Mean Maximum	12.1 15.8 19.5

Table D19.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Bull Gulch B and F	22°C Max 19°C Avg.	Ju1y 1 through July 31	14.5	+525.24	34.9	34.9	0.0	23.5	Minimum Mean Maximum	13.1 18.6 24.1
				+525.24	34.9	34.9	0.0	11.1	Minimum Mean Maximum	12.3 18.1 24.0
				+487.55	50.0	34.9	15.1	11.1	Minimum Mean Maximum	12.1 17.5 23.0
				+425.13	75.0	34.9	40.1	11.1	Minimum Mean Maximum	11.7 16.5 21.2
				+387.67	90.0	34.9	55.1	11.1	Minimum Mean Maximum	11.5 15.8 20.1
				+362.70	100.0	34.9	65.1	11.1	Minimum Mean Maximum	11.4 15.4 19.4
Upper Dickshooter Creek B and C	22°C Max 19°C Avg.	July 1 through July 31		+591.40	8.6	3.5	5.0	22.2	Minimum Mean Maximum	14.1 19.9 25.8
				+591.20	8.6	3.5	5.1	13.9	Minimum Mean Maximum	13.8 19.7 25.7
				+487.97	50.0	3.5	46.5	13.9	Minimum Mean Maximum	12.9 18.0 23.1
				+425.56	75.0	3.5	71.5	13.9	Minimum Mean Maximum	12.5 16.9 21.4
				+388.12	90.0	3.5	86.5	13.9	Minimum Mean Maximum	12.3 16.3 20.3
				+363.16	100.0	3.5	96.5	13.9	Minimum Mean Maximum	12.1 15.8 19.5

Table D20.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Deep Creek, Hurry Back to Current Creek G and F	22°C Max 19°C Avg.	Ju1y 1 through July 31	5	+11.36	34.9	34.9	0.0	24.0	Minimum Mean Maximum	14.7 19.3 23.9
Model Run does not Show Water Temperature Reductions Upstream				+24.83	34.9	34.9	0.0	12.3	Minimum Mean Maximum	14.6 19.1 23.6
				+15.93	50.0	34.9	15.1	12.3	Minimum Mean Maximum	14.5 22.7 18.6
				+0.46	75.0	34.9	40.1	12.3	Minimum Mean Maximum	14.2 17.8 21.2
				-9.26	90.0	34.9	55.1	12.3	Minimum Mean Maximum	14.2 17.2 20.3
				-15.92	100	34.9	65.1	12.3	Minimum Mean Maximum	14.1 16.9 19.7
Deep Creek, Hurry Back to Current Creek G and F	22°C Max 19°C Avg.	July 1 through July 31	5						Minimum Mean Maximum	15.2 19.8 24.2
Model Run Shows Water Temperature Reduction Achieved Upstream									Minimum Mean Maximum	15.8 19.9 24.1
									Minimum Mean Maximum	15.6 19.4 23.3
									Minimum Mean Maximum	15.4 18.6 21.8
									Minimum Mean Maximum	15.3 18.1 21.0
									Minimum Mean Maximum	15.2 17.8 20.4

Table D21.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	^oC
Red Canyon Creek A, B and F	22^oC Max 19^oC Avg.	Ju1y 1 through July 31	13.2	+523.71	34.9	34.9	0.0	24.1	Minimum Mean Maximum	12.0 17.9 23.8
				+523.71	34.9	34.9	0.0	12.6	Minimum Mean Maximum	11.1 17.2 23.4
				+485.90	50.0	34.9	15.1	12.6	Minimum Mean Maximum	11.0 16.6 22.3
				+423.40	75.0	34.9	40.1	12.6	Minimum Mean Maximum	10.8 15.7 20.6
				+385.90	90.0	34.9	55.1	12.6	Minimum Mean Maximum	10.7 15.1 19.4
				+360.90	100.0	34.9	65.1	12.6	Minimum Mean Maximum	10.7 11.7 18.7

Table D22.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Camel Creek A, B and G	13°C Max 9°C Avg.	June 1 through June 30	4.0	+237.91	16.3	11.2	5.1	26.6	Minimum Mean Maximum	7.9 12.7 17.5
				+233.74	17.9	11.2	6.7	11.9	Minimum Mean Maximum	8.0 12.8 17.5
				+151.22	50.0	11.2	38.8	11.9	Minimum Mean Maximum	7.9 11.2 14.6
				+86.89	75.0	11.2	63.8	11.9	Minimum Mean Maximum	7.8 10.0 12.3
				+48.44	90.0	11.2	78.8	11.9	Minimum Mean Maximum	7.7 9.3 10.8
				+22.74	100.0	11.2	88.8	11.9	Minimum Mean Maximum	7.7 8.8 9.8
Camas Creek A, B and G	13°C Max 9°C Avg.	June 1 through June 30	8.9	+260.69	7.3	0.9	6.4	23.6	Minimum Mean Maximum	9.2 13.8 18.5
				+259.21	7.9	0.9	7.0	13.2	Minimum Mean Maximum	8.9 13.6 18.2
				+150.92	50.0	0.9	49.1	13.2	Minimum Mean Maximum	8.3 11.5 14.6
				+86.64	75.0	0.9	74.1	13.2	Minimum Mean Maximum	8.0 10.2 12.2
				+48.07	90.0	0.9	89.1	13.2	Minimum Mean Maximum	7.9 9.3 10.8
				+22.35	100.0	0.9	99.1	13.2	Minimum Mean Maximum	7.8 8.8 9.8

Table D23.

Stream Name Rosgen Channel Type	Target Temperature	Model Run Dates	Segment Length (mi.)	Solar Radiation Components 24 hours (+/-) (joules/m^2/sec)	% Total Shade	% Topo Shade	% Veg Shade	Width/ Depth Ratio	Temperature (24 hours)	°C
Deep Creek, Current to Pole Creek F	13°C Max 9°C Avg.	June 1 through June 30	15.8	+145.86	34.4	34.4	0.0	27.6	Minimum Mean Maximum	9.5 12.3 15.1
				+149.64	34.4	34.4	0.0	11.6	Minimum Mean Maximum	9.3 11.7 14.2
				+109.78	50.0	34.4	15.6	11.6	Minimum Mean Maximum	9.1 11.1 13.2
				+45.75	75.0	34.4	40.6	11.6	Minimum Mean Maximum	8.9 10.2 11.5
				+7.34	90.0	34.4	55.6	11.6	Minimum Mean Maximum	8.7 9.6 10.5
				-18.27	100.0	34.4	66.6	11.6	Minimum Mean Maximum	8.6 9.2 9.8
Upper Pole Creek A, B, C and F	13°C Max 9°C Avg.	June 1 through June 30	6.8	+241.66	14.7	1.7	13.0	22.4	Minimum Mean Maximum	8.5 13.1 17.6
				+238.59	15.9	1.7	14.2	11.5	Minimum Mean Maximum	8.1 12.6 17.2
				+150.83	50.0	1.7	48.3	11.5	Minimum Mean Maximum	7.9 11.1 14.2
				+86.53	75.0	1.7	73.3	11.5	Minimum Mean Maximum	7.8 9.9 12.0
				+47.95	90.0	1.7	88.3	11.5	Minimum Mean Maximum	7.8 9.2 10.6
				+22.24	100.0	1.7	98.3	11.5	Minimum Mean Maximum	7.8 8.7 9.7

Table D24. Discharge-Load Calculations

Sediment Discharge

Castle Creek						
Mean annual Discharge	Load Capacity 80 mg/l	Load Capacity ^@ 80 mg/l	Load Capacity 50 mg/l	Load Capacity ^@ 50 mg/l	Load Capacity ^@ 80 mg/l	Load Capacity ^@ 50 mg/l
cfs	mg/l	lbs/day	mg/l	lbs/day	tons/year	tons/year
11.8	80	2.3E+03	50	1.44E+03	1.54E+05	9.61E+04

Deep Creek						
Mean annual Discharge	Load Capacity 80 mg/l	Load Capacity ^@ 80 mg/l	Load Capacity 50 mg/l	Load Capacity ^@ 50 mg/l	Load Capacity ^@ 80 mg/l	Load Capacity ^@ 50 mg/l
cfs	mg/l	lbs/day	mg/l	lbs/day	tons/year	tons/year
52.03	80	1.0E+04	50	6.36E+03	6.78E+05	4.24E+05

Blue Creek						
Mean annual Discharge	Load Capacity 80 mg/l	Load Capacity ^@ 80 mg/l	Load Capacity 50 mg/l	Load Capacity ^@ 50 mg/l	Load Capacity ^@ 80 mg/l	Load Capacity ^@ 50 mg/l
cfs	mg/l	lbs/day	mg/l	lbs/day	tons/year	tons/year
6.74	80	1.3E+03	50	8.24E+02	8.79E+04	5.49E+04

Juniper Creek						
Mean annual Discharge	Load Capacity 80 mg/l	Load Capacity ^@ 80 mg/l	Load Capacity 50 mg/l	Load Capacity ^@ 50 mg/l	Load Capacity ^@ 80 mg/l	Load Capacity ^@ 50 mg/l
cfs	mg/l	lbs/day	mg/l	lbs/day	tons/year	tons/year
1.96	80	3.84E+02	50	2.40E+02	2.55E+04	1.60E+04

Table D25. Discharge-Load Calculations

Reverse load Analysis
Tons to
mg/l

Deep Creek												
	Low Yeild	Low Yeild	Low Yeild	Low Yeild	Conversion	mg sec	Flow	mg/cubic foot	Concentration			
	Bank Erosion	Bank Erosion	Bank Erosion	Bank Erosion	kg to mg							
					1E-06 or							
	tons/year	tons/day	kg/day	mg/day	0.000001				mg/l			
	3420.00	9.4	8498.5	8.50E+09	1.00E-06	98362	52	1891.57	66.8			

Deep Creek												
		Load Capacity	Conversion	mg/cubic foot	Conversion	Kg/cf	Conversion	Sediment load	Conversion	Tons per	Number of	Tons/year
	Mean annual	Concentration	Factor		mg to kg		seconds/day	at kg/day	kg to tons	day	Days/year	
	Discharge		cubic feet to		1E-06 or				1kg =			
	cfs	mg/l	liters		0.000001				0.0011 tons		365	
	52	66.8	28.312	9.84E+04	1.00E-06	9.84E-02	86400	8.50E+03	0.0011	9.35E+00	365	3412

Deep Creek												
	High Yield	High Yield	High Yield	High Yield	Conversion	mg sec	Flow	mg/cubic foot	Concentration			
	Bank Erosion	Bank Erosion	Bank Erosion	Bank Erosion	kg to mg							
					1E-06 or							
	tons/year	tons/day	kg/day	mg/day	0.000001				mg/l			
	56196.00	154.0	139643.2	1.40E+11	1.00E-06	1616241	52	31081.56	1097.7			

Deep Creek												
		Load Capacity	Conversion	mg/cubic foot	Conversion	Kg/cf	Conversion	Sediment load	Conversion	Tons per	Number of	Tons/year
	Mean annual		Factor		mg to kg		seconds/day	at kg/day	kg to tons	day	Days/year	
	Discharge		cubic feet to		1E-06 or				1kg =			
	cfs	mg/l	liters		0.000001				0.0011 tons		365	
	52	1097.7	28.312	1.62E+06	1.00E-06	1.62E+00	86400	1.40E+05	0.0011	1.54E+02	365	56061

Table D26. Discharge-Load Calculations

Reverse load Analysis
Tons to
mg/l

Castle Creek												
	Low Yeild	Low Yeild	Low Yeild	Low Yeild	Conversion	mg sec	Flow	mg/cubic foot	Concentration			
	Bank Erosion	Bank Erosion	Bank Erosion	Bank Erosion	kg to mg							
					1E-06 or							
	tons/year	tons/day	kg/day	mg/day	0.000001				mg/l			
	156.00	0.4	387.6	3.88E+08	1.00E-06	4487	11.8	380.23	13.4			

Castle Creek												
		Load Capacity	Conversion	mg/cubic foot	Conversion	Kg/cf	Conversion	Sediment load	Conversion	Tons per	Number of	Tons/year
	Mean annual	Concentration	Factor		mg to kg		seconds/day	at kg/day	kg to tons	day	Days/year	
	Discharge		cubic feet to		1E-06 or				1kg =			
	cfs	mg/l	liters		0.000001				0.0011 tons		365	
	11.8	13.4	28.312	4.49E+03	1.00E-06	4.49E-03	86400	3.88E+02	0.0011	4.26E-01	365	156

Castle Creek												
	High Yield	High Yield	High Yield	High Yield	Conversion	mg sec	Flow	mg/cubic foot	Concentration			
	Bank Erosion	Bank Erosion	Bank Erosion	Bank Erosion	kg to mg							
					1E-06 or							
	tons/year	tons/day	kg/day	mg/day	0.000001				mg/l			
	2580.00	7.1	6411.1	6.41E+09	1.00E-06	74203	11.8	6288.37	222.1			

Castle Creek												
		Load Capacity	Conversion	mg/cubic foot	Conversion	Kg/cf	Conversion	Sediment load	Conversion	Tons per	Number of	Tons/year
	Mean annual		Factor		mg to kg		seconds/day	at kg/day	kg to tons	day	Days/year	
	Discharge		cubic feet to		1E-06 or				1kg =			
	cfs	mg/l	liters		0.000001				0.0011 tons		365	
	11.8	222.1	28.312	7.42E+04	1.00E-06	7.42E-02	86400	6.41E+03	0.0011	7.05E+00	365	2574

Table D27. Discharge-Load Calculations

Reverse load Analysis
Tons to mg/l

Juniper Creek												
	Low Yeild	Low Yeild	Low Yeild	Low Yeild	Conversion	mg sec	Flow	mg/cubic foot	Concentration			
	Bank Erosion	Bank Erosion	Bank Erosion	Bank Erosion	kg to mg							
					1E-06 or							
	tons/year	tons/day	kg/day	mg/day	0.000001				mg/l			
	492.00	1.3	1222.6	1.22E+09	1.00E-06	14150	2	7075.15	249.9			

Juniper Creek												
		Load Capacity	Conversion	mg/cubic foot	Conversion	Kg/cf	Conversion	Sediment load	Conversion	Tons per	Number of	Tons/year
	Mean annual	Concentration	Factor		mg to kg		seconds/day	at kg/day	kg to tons	day	Days/year	
	Discharge		cubic feet to		1E-06 or				1kg =			
	cfs	mg/l	liters		0.000001				0.0011 tons		365	
	2	249.9	28.312	1.41E+04	1.00E-06	1.41E-02	86400	1.22E+03	0.0011	1.34E+00	365	491

Juniper Creek												
	High Yield	High Yield	High Yield	High Yield	Conversion	mg sec	Flow	mg/cubic foot	Concentration			
	Bank Erosion	Bank Erosion	Bank Erosion	Bank Erosion	kg to mg							
					1E-06 or							
	tons/year	tons/day	kg/day	mg/day	0.000001				mg/l			
	8100.00	22.2	20127.9	2.01E+10	1.00E-06	232962	2	116481.16	4113.8			

Juniper Creek												
		Load Capacity	Conversion	mg/cubic foot	Conversion	Kg/cf	Conversion	Sediment load	Conversion	Tons per	Number of	Tons/year
	Mean annual		Factor		mg to kg		seconds/day	at kg/day	kg to tons	day	Days/year	
	Discharge		cubic feet to		1E-06 or				1kg =			
	cfs	mg/l	liters		0.000001				0.0011 tons		365	
	2	4113.8	28.312	2.33E+05	1.00E-06	2.33E-01	86400	2.01E+04	0.0011	2.21E+01	365	8081

Table D28. Discharge-Load Calculations

Reverse load Analysis
Tons to mg/l

Blue Creek												
	Low Yeild	Low Yeild	Low Yeild	Low Yeild	Conversion	mg sec	Flow	mg/cubic foot	Concentration			
	Bank Erosion	Bank Erosion	Bank Erosion	Bank Erosion	kg to mg							
					1E-06 or							
	tons/year	tons/day	kg/day	mg/day	0.000001				mg/l			
	326.00	0.9	810.1	8.10E+08	1.00E-06	9376	6.7	1399.41	49.4			

Blue Creek												
		Load Capacity	Conversion	mg/cubic foot	Conversion	Kg/cf	Conversion	Sediment load	Conversion	Tons per	Number of	Tons/year
	Mean annual	Concentration	Factor		mg to kg		seconds/day	at kg/day	kg to tons	day	Days/year	
	Discharge		cubic feet to		1E-06 or				1kg =			
	cfs	mg/l	liters		0.000001				0.0011 tons		365	
	6.7	49.4	28.312	9.38E+03	1.00E-06	9.38E-03	86400	8.10E+02	0.0011	8.91E-01	365	325

Blue Creek												
	High Yield	High Yield	High Yield	High Yield	Conversion	mg sec	Flow	mg/cubic foot	Concentration			
	Bank Erosion	Bank Erosion	Bank Erosion	Bank Erosion	kg to mg							
					1E-06 or							
	tons/year	tons/day	kg/day	mg/day	0.000001				mg/l			
	5370.00	14.7	13344.1	1.33E+10	1.00E-06	154445	6.7	23051.55	814.1			

Blue Creek												
		Load Capacity	Conversion	mg/cubic foot	Conversion	Kg/cf	Conversion	Sediment load	Conversion	Tons per	Number of	Tons/year
	Mean annual		Factor		mg to kg		seconds/day	at kg/day	kg to tons	day	Days/year	
	Discharge		cubic feet to		1E-06 or				1kg =			
	cfs	mg/l	liters		0.000001				0.0011 tons		365	
	6.7	814.1	28.312	1.54E+05	1.00E-06	1.54E-01	86400	1.33E+04	0.0011	1.47E+01	365	5357

Table D29. Discharge-Load Calculations

Reverse load Analysis
Tons to mg/l

Nickel Creek												
	Low Yeild	Low Yeild	Low Yeild	Low Yeild	Conversion	mg sec	Flow	mg/cubic foot	Concentration			
	Bank Erosion	Bank Erosion	Bank Erosion	Bank Erosion	kg to mg							
					1E-06 or							
	tons/year	tons/day	kg/day	mg/day	0.000001				mg/l			
	23.50	0.1	58.4	5.84E+07	1.00E-06	676	0.4	1689.70	59.7			

Nickel Creek												
		Load Capacity	Conversion	mg/cubic foot	Conversion	Kg/cf	Conversion	Sediment load	Conversion	Tons per	Number of	Tons/year
	Mean annual	Concentration	Factor		mg to kg		seconds/day	at kg/day	kg to tons	day	Days/year	
	Discharge		cubic feet to		1E-06 or				1kg =			
	cfs	mg/l	liters		0.000001				0.0011 tons		365	
	0.4	59.7	28.312	6.76E+02	1.00E-06	6.76E-04	86400	5.84E+01	0.0011	6.42E-02	365	23

Nickel Creek												
	High Yield	High Yield	High Yield	High Yield	Conversion	mg sec	Flow	mg/cubic foot	Concentration			
	Bank Erosion	Bank Erosion	Bank Erosion	Bank Erosion	kg to mg							
					1E-06 or							
	tons/year	tons/day	kg/day	mg/day	0.000001				mg/l			
	387.00	1.1	961.7	9.62E+08	1.00E-06	11130	0.4	27826.06	982.7			

Nickel Creek												
		Load Capacity	Conversion	mg/cubic foot	Conversion	Kg/cf	Conversion	Sediment load	Conversion	Tons per	Number of	Tons/year
	Mean annual		Factor		mg to kg		seconds/day	at kg/day	kg to tons	day	Days/year	
	Discharge		cubic feet to		1E-06 or				1kg =			
	cfs	mg/l	liters		0.000001				0.0011 tons		365	
	0.4	982.7	28.312	1.11E+04	1.00E-06	1.11E-02	86400	9.62E+02	0.0011	1.06E+00	365	386

Table D30 12 Month Discharge Model Castle Creek

Estimated Flows Table
6th Field HUC
17050104 0603 Castle Creek

Area	Area	Mean Basin Elevation	Basin Relief	Slopes >30%		Mean Annual Precip.	Landuse Forested	Basin Slope Average	Distance Total	Distance ^10 & 85%	Elevation Change	Elevation Change ^@10 and 85 %		Main Channel Slope
Acres	Miles	feet	feet	%		in	%	%	miles	miles	meters	feet		ft/miles
15372	24	6400	1664	20		14.6	30	20	11	10		1280		155.15

A=	24	Total						
E=	5.4	Discharge		A	BS	S30	F	Total
BR=	1664	Power		0.963	-3.44	2.52	0.646	Discharge
S30=S+1%=	21			24	20	21	31	cfs
P=	14.6							
F=	31	Qa=	8.37E-01	21.34	0.0000335	2147.79	9.19	11.80
BS=	20							
MCS=	155.2							

Power	MCS	F	P		
June					
Q80	-1.46	0.775	1.21		
Q50	-1.53	0.844	1.65		
Q20	-1.55	0.793	1.9		
June		MCS	F	P	Flow
Q.80=	5.47E+01	0.0006331	14.3155	25.64	12.71
Q.50=	3.59E+01	0.0004448	18.143	83.40	24.16
Q.20=	4.31E+01	0.0004021	15.2282	163.03	43.03

Power	MCS	F	P		
July					
Q80	-1.21	0.587	0.0617		
Q50	-1.36	0.698	0.464		
Q20	-1.55	0.734	0.876		
July		MCS	F	P	Flow
Q.80=	2.66E+02	2.23E-03	7.50636	1.18	5.26
Q.50=	2.43E+02	1.05E-03	10.9893	3.47	9.71
Q.20=	2.85E+02	4.02E-04	12.4354	10.47	14.92

Power	MCS		F		
August					
Q80	-1.03		0.465		
Q50	-1.28		0.57		
Q20	-1.39		0.648		
August			MCS	F	Flow
Q.80=	1.34E+02		5.54E-03	4.93723	3.67
Q.50=	4.80E+02		1.57E-03	7.0807	5.34
Q.20=	9.86E+02		9.01E-04	9.25555	8.22

Standard Error				Flow		Flow	Standard Error				Flow	Flow			Standard Error					Flow	Flow
June				cfs		cfs	July				cfs	cfs			August					cfs	cfs

Q80	143.7%	to	-59.0%	**30.98**		**5.21**	Q80	185.6%	to	-65.0%	**15.03**	**1.84**			Q80	214.8%		to	-68.2%	**11.54**	**1.17**
Q50	165.6%		-62.4%	**64.17**		**39.24**	Q50	155.3%		-60.8%	**24.80**	**3.81**			Q50	195.7%			-66.2%	**15.78**	**1.80**
Q20	167.4%		-62.6%	**115.05**		**69.96**	Q20	140.0%		-58.3%	**35.81**	**6.22**			Q20	163.3%			-62.0%	**21.66**	**3.13**

Power September	MCS	F
Q80	-0.992	0.469
Q50	-1.23	0.503
Q20	-1.36	0.547

September		MCS	F	Flow
Q.80=	1.10E+02	0.0067107	5.00551	3.69
Q.50=	3.98E+02	0.0020201	5.62542	4.52
Q.20=	9.48E+02	0.0010485	6.54297	6.50

Power October	MCS	F
Q80	-1.09	0.432
Q50	-1.27	0.523
Q20	-1.43	0.598

October		MCS	F	Flow
Q.80=	2.27E+02	4.09E-03	4	4.10
Q.50=	5.77E+02	1.65E-03	6	5.74
Q.20=	1.56E+03	7.37E-04	8	8.96

Power November	MCS	F
Q80	-1.26	0.503
Q50	-1.36	0.568
Q20	-1.42	0.594

November		MCS	F	Flow
Q.80=	5.28E+02	1.74E-03	5.62542	5.16
Q.50=	9.89E+02	1.05E-03	7.03224	7.29
Q.20=	1.71E+03	7.75E-04	7.68898	10.19

Standard Error				**Flow**		**Flow**	Standard Error				**Flow**	**Flow**			Standard Error					**Flow**	**Flow**
September				**cfs**		**cfs**	October				**cfs**	**cfs**			November					**cfs**	**cfs**
Q80	204.1%	to	-67.1%	**11.24**		**1.22**	Q80	161.2%	to	-61.7%	**10.70**	**1.57**			Q80	115.9%		to	-53.7%	**11.13**	**2.39**
Q50	192.2%		-65.8%	**13.22**		**1.55**	Q50	137.8%		-58.0%	**13.65**	**2.41**			Q50	99.2%			49.8%	**14.53**	**10.92**
Q20	172.3%		-63%	**17.71**		**2.39**	Q20	103.6%		50.9%	**18.24**	**13.52**			Q20	89.8%			47.3%	**19.33**	**15.00**

Power December	MCS	F	P
Q80	-1.26	0.507	
Q50	-1.35	0.565	
Q20	-1.29	0.606	

Power January	E	S30	MCS	F
Q80	-0.526	0.209	-1.33	0.485
Q50	-1.55	0.468	-1.41	0.548
Q20	-3.85	1.02	-1.49	0.705

Power February	E	S30	MCS	F
Q80	-1.130	0.488	-1.47	0.47
Q50	-3.06	0.939	-1.53	0.548
Q20	-4.06	1.21	-1.56	0.515

December	MCS	F	P	Flow

January	E	S30	MCS	F	Flow

February	E	S30	MCS	F	Flow

Q.80=	5.97E+02	0.0017364	5.70322	1.00		5.91
Q.50=	1.02E+03	0.0011028	6.96016	1.00		7.83
Q.20=	1.14E+03	0.0014925	8.01245	1.00		13.63

Q.80=	1.16E+03	4.12E-01	1.88949	0.001220	5.3	5.82
Q.50=	5.82E+03	7.32E-02	4.15718	0.000815	6.6	9.48
Q.20=	1.27E+05	1.51E-03	22.3184	0.000544	11.3	26.30

Q.80=	3.94E+03		1.49E-01	4.41818	0.000602	5.0	7.83E+00
Q.50=	5.18E+04		5.74E-03	17.4407	0.000445	6.6	1.51E+01
Q.20=	3.05E+05		1.06E-03	39.8002	0.000382	5.9	2.89E+01

Standard Error				Flow		Flow
December				cfs		cfs
Q80	91.9%	to	-47.9%	**11.35**		**3.08**
Q50	91.2%		47.7%	**14.97**		**11.56**
Q20	107.0%		51.7%	**28.22**		**20.68**

Standard Error				Flow	Flow		
January				cfs	cfs		
Q80	90.9%	to	-47.6%	**11.12**	**2.77**		
Q50	88.4%		-47.7%	**17.86**	**3.43**		
Q20	89.2%		-51.7%	**49.76**	**5.44**		

Standard Error					Flow	Flow
February					cfs	cfs
Q80	88.1%		to	-46.8%	**14.72**	**2.67**
Q50	99.7%			-49.9%	**30.24**	**3.29**
Q20	125.4%			-55.6%	**65.18**	**2.60**

Power	A	E	S30	F
March				
Q80	0.922	-1.75	0.354	0.537
Q50	1	-2.97	0.684	0.546
Q20	1.04	-3.59	0.82	0.470

March		A	E	S30	F	Flow
Q.80=	4.10E-01	18.73073	5.2E-02	2.94	6.32	7.46
Q.50=	1.58E+00	24.00000	6.7E-03	8.02	6.52	13.25
Q.20=	6.34E+00	27.25334	2.3E-03	12.14	5.02	24.74

Power	BS	S30	MCS	F
April				
Q80	-3.340	2.8	-1.52	0.795
Q50	-2.12	2.01	-1.55	0.746
Q20	-0.607	1.02	-1.57	0.57

April		BS	S30	MCS	F	Flow
Q.80=	1.17E+04	4.51E-05	5037.49	0.000468	15.333	19.15
Q.50=	9.86E+03	1.75E-03	454.633	0.000402	13.0	40.76
Q.20=	7.66E+03	1.62E-01	22.3184	0.000364	7.1	71.41

Power	MCS		F	P
May				
Q80	-1.480		0.817	1.9
Q50	-1.49		0.862	2.13
Q20	-1.43		0.699	2.26

May			F	P	Flow
Q.80=	1.28E+00	5.72E-04	16.54	163.031	1.98
Q.50=	1.38E+00	5.44E-04	13.23	302.045	3.00
Q.20=	1.91E+00	7.37E-04	33.99	427.994	20.47

Standard Error				Flow		Flow
March				cfs		cfs
Q80	131.0%	to	-56.7%	**17.23**		**3.23**
Q50	139.1%		-58.3%	**31.69**		**5.53**
Q20	132.2%		-56.9%	**57.44**		**10.66**

Standard Error				Flow	Flow		
April				cfs	cfs		
Q80	110.5%	to	-52.5%	**40.31**	**9.10**		
Q50	139.6%		-58.3%	**97.66**	**17.00**		
Q20	161.5%		61.8%	**186.74**	**115.54**		

Standard Error					Flow	Flow
May					cfs	cfs
Q80	151.5%		to	-60.2%	**4.97**	**0.79**
Q50	180.3%			-64.3%	**8.41**	**1.07**
Q20	163.9%			-62.6%	**54.01**	**7.65**

Table D31 12 Month Discharge Model Blue Creek

Estimated Flows
6th Field HUC
Blue Creek Reservoir

Area Acres	Area Miles	Mean Basin Elevation feet	Basin Relief feet	Slopes >30% %		Mean Annual Precip. in	Landuse Forested %	Basin Slope Average %	Distance Total miles	Distance ^10 & 85% miles	Elevation Change meters	Elevation Change ^@10 and 85 % feet		Main Channel Slope ft/miles
39224	61.3	5760	800	10		15	0	10	20.2	13.8		620		40.92

A=	61.3	Total							
E=	5.4	Discharge		A	BS	S30	F	Total	
BR=	800	Power		0.963	-3.44	2.52	0.646	Discharge	
S30=S+1%=	11			61.3	10	11	1	cfs	
P=	15								
F=	1	Qa=	8.37E-01	52.64	######	421.03	1.00	6.74	
BS=	10								
MCS=	40.9								

Power	MCS	F	P		
June					
Q80	-1.46	0.775	1.21		
Q50	-1.53	0.844	1.65		
Q20	-1.55	0.793	1.9		
June		MCS	F	P	Flow
Q.80=	5.47E+01	0.004431	1	26.49	6.42
Q.50=	3.59E+01	0.003417	1	87.21	10.70
Q.20=	4.31E+	0.003173	1	171.62	23.47

Power	MCS	F	P		
July					
Q80	-1.21	0.587	0.0617		
Q50	-1.36	0.698	0.464		
Q20	-1.55	0.734	0.876		
July		MCS	F	P	Flow
Q.80=	2.66E+02	1.12E-02	1	1.18	3.52
Q.50=	2.43E+02	6.42E-03	1	3.51	5.48
Q.20=	2.85E+02	3.17E-03	1	10.72	9.69

Power	MCS	F		
August				
Q80	-1.03	0.465		
Q50	-1.28	0.57		
Q20	-1.39	0.648		
August		MCS	F	Flow
Q.80=	1.34E+02	2.19E-02	1	2.93
Q.50=	4.80E+02	8.64E-03	1	4.15
Q.20=	9.86E+02	5.75E-03	1	5.67

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Standard Error				Flow		Flow	Standard Error				Flow	Flow			Standard Error				Flow	Flow
June				cfs		cfs	July				cfs	cfs			August				cfs	cfs
Q80	143.7%	to	-59.0%	**15.65**		**2.63**	Q80	185.6%	to	-65.0%	**10.06**	**1.23**			Q80	214.8%	to	-68.2%	**9.22**	**0.93**
Q50	165.6%		-62.4%	**28.41**		**17.37**	Q50	155.3%		-60.8%	**14.00**	**2.15**			Q50	195.7%		-66.2%	**12.27**	**1.40**
Q20	167.4%		-62.6%	**62.75**		**38.16**	Q20	140.0%		-58.3%	**23.27**	**4.04**			Q20	163.3%		-62.0%	**14.92**	**2.15**

Power	MCS	F	Power	MCS	F	Power	MCS	F
September			October			November		
Q80	-0.992	0.469	Q80	-1.09	0.432	Q80	-1.26	0.503
Q50	-1.23	0.503	Q50	-1.27	0.523	Q50	-1.36	0.568
Q20	-1.36	0.547	Q20	-1.43	0.598	Q20	-1.42	0.594

September	MCS	F		Flow	October	MCS	F		Flow	November	MCS	F		Flow
Q.80=	1.10E+02	0.025172	1	2.77	Q.80=	2.27E+02	1.75E-02	1	3.97	Q.80=	5.28E+02	9.31E-03	1	4.92
Q.50=	3.98E+02	0.010406	1	4.14	Q.50=	5.77E+02	8.97E-03	1	5.18	Q.50=	9.89E+02	6.42E-03	1	6.35
Q.20=	9.48E+02	0.006423	1	6.09	Q.20=	1.56E+03	4.95E-03	1	7.73	Q.20=	1.71E+03	5.14E-03	1	8.79

Standard Error				Flow		Flow	Standard Error				Flow	Flow			Standard Error				Flow	Flow
September				cfs		cfs	October				cfs	cfs			Novemebr				cfs	cfs
Q80	204.1%	to	-67.1%	**8.42**		**0.91**	Q80	161.2%	to	-61.7%	**10.37**	**1.52**			Q80	115.9%	to	-53.7%	**10.61**	**2.28**
Q50	192.2%		-65.8%	**12.10**		**1.42**	Q50	137.8%		-58.0%	**12.31**	**2.17**			Q50	99.2%		49.8%	**12.65**	**9.52**
Q20	172.3%		-63%	**16.58**		**2.23**	Q20	103.6%		50.9%	**15.73**	**11.66**			Q20	89.8%		47.3%	**16.68**	**12.95**

Power	MCS	F	P	Power	E	S30	MCS	F	Power	E	S30	MCS	F
December				January					February				

Q80	-1.26	0.507		
Q50	-1.35	0.565		
Q20	-1.29	0.606		

Q80	-0.526	0.209	-1.33	0.485
Q50	-1.55	0.468	-1.41	0.548
Q20	-3.85	1.02	-1.49	0.705

Q80	-1.130	0.488	-1.47	0.47
Q50	-3.06	0.939	-1.53	0.548
Q20	-4.06	1.21	-1.56	0.515

December		MCS	F	P	Flow
Q.80=	5.97E+02	0.009309	1	1.00	5.56
Q.50=	1.02E+03	0.006665	1	1.00	6.80
Q.20=	1.14E+03	0.008328	1	1.00	9.49

January		E	S30	MCS	F	Flow
Q.80=	1.16E+03	4.12E-01	1.650635	0.007179	1.0	5.66
Q.50=	5.82E+03	7.32E-02	3.07165	0.005335	1.0	6.99
Q.20=	1.27E+05	1.51E-03	11.54039	0.003964	1.0	8.80

February	E	S30	MCS	F	
Q.80=	3.94E+03	1.49E-01	3.22255	0.004270	1.0
Q.50=	5.18E+04	5.74E-03	9.503153	0.003417	1.0
Q.20=	3.05E+05	1.06E-03	18.20058	0.003057	1.0

Standard Error				Flow		Flow
December				cfs		cfs
Q80	91.9%	to	-47.9%	**10.66**		**2.90**
Q50	91.2%		-47.7%	**13.00**		**3.56**
Q20	107.0%		-51.7%	**19.65**		**4.59**

Standard Error				Flow	Flow		
January				cfs	cfs		
Q80	90.9%	to	-47.6%	**10.81**	**0.52**		
Q50	88.4%		-47.7%	**13.16**	**0.52**		
Q20	89.2%		-51.7%	**16.65**	**0.48**		

Standard Error				Flow	Flow
February				cfs	cfs
Q80	88.1%	to	-46.8%	**15.17**	**0.53**
Q50	99.7%		-49.9%	**19.28**	**0.50**
Q20	125.4%		-55.6%	**40.66**	**0.44**

Power March	A	E	S30	F
Q80	0.922	-1.75	0.354	0.537
Q50	1	-2.97	0.684	0.546
Q20	1.04	-3.59	0.82	0.470

Power April	BS	S30	MCS	F
Q80	-3.340	2.8	-1.52	0.795
Q50	-2.12	2.01	-1.55	0.746
Q20	-0.607	1.02	-1.57	0.57

Power May	MCS	F	P
Q80	-1.480	0.817	1.9
Q50	-1.49	0.862	2.13
Q20	-1.43	0.699	2.26

June		A	E	S30	F	Flow
Q.80=	4.10E-01	44.46707	5.2E-02	2.34	1.00	2.23
Q.50=	1.58E+00	61.30000	6.7E-03	5.16	1.00	3.34
Q.20=	6.34E+00	72.27014	2.3E-03	7.14	1.00	7.69

April		BS	S30	MCS	F	Flow
Q.80=	1.17E+04	4.57E-04	823.9475	0.003546	1.0	15.68
Q.50=	9.86E+03	7.59E-03	123.9365	0.003173	1.0	29.41
Q.20=	7.66E+03	2.47E-01	11.54039	0.002946	1.0	64.36

July		F	P	Flow
Q.80=	1.28E+00	1	9.138324	11.70
Q.50=	1.38E+00	1	10.32264	14.25
Q.20=	1.91E+00	1	6.638773	12.68

Standard Error			Flow		Flow	Standard Error			Flow	Flow			Standard Error			Flow	Flow

March				cfs		cfs	April				cfs	cfs			May				cfs	cfs
Q80	131.0%	to	-56.7%	**5.15**		**0.96**	Q80	110.5%	to	-52.5%	**33.01**	**7.45**			Q80	151.5%	to	-60.2%	**29.42**	**4.66**
Q50	139.1%		-58.3%	**7.98**		**1.39**	Q50	139.6%		-58.3%	**70.47**	**12.26**			Q50	180.3%		-64.3%	**39.93**	**5.09**
Q20	132.2%		-56.9%	**17.85**		**3.31**	Q20	161.5%		61.8%	**168.31**	**104.14**			Q20	163.9%		-62.6%	**33.46**	**4.74**

Table D32 12 Month Discharge Model Juniper Creek

Estimated Flows
6th Field HUC
170501 040603 Juniper Basin

Area	Area	Mean Basin Elevation	Basin Relief	Slopes >30%		Mean Annual Precip.	Landuse Forested	Basin Slope Average	Distance Total	Distance ^10 & 85%	Elevation Change	Elevation Change ^@10 and 85 %		Main Channel Slope
Acres	Miles	feet	feet	%		in	%	%	miles	miles	meters	feet		ft/miles
53051	82.9	5400	400	5		14.6	0	10	12.9	10.6		482		49.82

					A	BS	S30	F	Total
A=	82.9	Total Discharge							
E=	5.4	Power			0.963	-3.44	2.52	0.646	Discharge
BR=	400				82.9	10	6	1	cfs
S30=S+1%=	6								
P=	14.6								
F=	1	Qa=	8.37E-01		70.40	0.0003631	91.40	1.00	1.96
BS=	10								
MCS=	49.8								

Power June	MCS	F	P
Q80	-1.46	0.775	1.21
Q50	-1.53	0.844	1.65
Q20	-1.55	0.793	1.9

June		MCS	F	P	Flow
Q.80=	5.47E+01	0.003325077	1	25.64	4.66
Q.50=	3.59E+01	0.002529205	1	83.40	7.57
Q.20=	4.31E+01	0.002339032	1	163.03	16.44

Power July	MCS	F	P
Q80	-1.21	0.587	0.0617
Q50	-1.36	0.698	0.464
Q20	-1.55	0.734	0.876

July		MCS	F	P	Flow
Q.80=	2.66E+02	8.83E-03	1	1.18	2.77
Q.50=	2.43E+02	4.92E-03	1	3.47	4.14
Q.20=	2.85E+02	2.34E-03	1	10.47	6.98

Power August	MCS	F
Q80	-1.03	0.465
Q50	-1.28	0.57
Q20	-1.39	0.648

August		MCS	F	Flow
Q.80=	1.34E+02	1.79E-02	1	2.39
Q.50=	4.80E+02	6.72E-03	1	3.23
Q.20=	9.86E+02	4.37E-03	1	4.31

Standard Error				Flow		Flow
June				cfs		cfs
Q80	143.7%	to	-59.0%	**11.36**		**1.91**
Q50	165.6%		-62.4%	**20.11**		**12.30**
Q20	167.4%		-62.6%	**43.95**		**26.72**

Standard Error				Flow	Flow
July				cfs	cfs
Q80	185.6%	to	-65.0%	**7.92**	**0.97**
Q50	155.3%		-60.8%	**10.58**	**1.62**
Q20	140.0%		-58.3%	**16.75**	**2.91**

Standard Error				Flow	Flow
August				cfs	cfs
Q80	214.8%	to	-68.2%	**7.53**	**0.76**
Q50	195.7%		-66.2%	**9.54**	**1.09**
Q20	163.3%		-62.0%	**11.35**	**1.64**

Power September	MCS	F
Q80	-0.992	0.469
Q50	-1.23	0.503
Q20	-1.36	0.547

September		MCS	F	Flow
Q.80=	1.10E+02	0.020710143	1	2.28
Q.50=	3.98E+02	0.008169639	1	3.25
Q.20=	9.48E+02	0.004915202	1	4.66

Standard Error				Flow		Flow
September				cfs		cfs
Q80	204.1%	to	-67.1%	**6.93**		**0.75**
Q50	192.2%		-65.8%	**9.50**		**1.11**
Q20	172.3%		-63%	**12.69**		**1.71**

Power October	MCS	F
Q80	-1.09	0.432
Q50	-1.27	0.523
Q20	-1.43	0.598

October		MCS	F	Flow
Q.80=	2.27E+02	1.41E-02	1	3.21
Q.50=	5.77E+02	6.99E-03	1	4.03
Q.20=	1.56E+03	3.74E-03	1	5.83

Standard Error				Flow	Flow		
October				cfs	cfs		
Q80	161.2%	to	-61.7%	**8.37**	**1.23**		
Q50	137.8%		-58.0%	**9.59**	**1.69**		
Q20	103.6%		50.9%	**11.87**	**8.80**		

Power November	MCS	F
Q80	-1.26	0.503
Q50	-1.36	0.568
Q20	-1.42	0.594

November		MCS	F	Flow
Q.80=	5.28E+02	7.27E-03	1	3.84
Q.50=	9.89E+02	4.92E-03	1	4.86
Q.20=	1.71E+03	3.89E-03	1	6.65

Standard Error				Flow	Flow
Novemebr				cfs	cfs
Q80	115.9%	to	-53.7%	**8.28**	**1.78**
Q50	99.2%		49.8%	**9.68**	**7.28**
Q20	89.8%		47.3%	**12.62**	**9.79**

Power December	MCS	F	P
Q80	-1.26	0.507	
Q50	-1.35	0.565	
Q20	-1.29	0.606	

December		MCS	F	P	Flow
Q.80=	5.97E+02	0.007265759	1	1.00	4.34
Q.50=	1.02E+03	0.005111111	1	1.00	5.21
Q.20=	1.14E+03	0.006461883	1	1.00	7.37

Standard Error				Flow		Flow
December				cfs		cfs
Q80	91.9%	to	-47.9%	**8.32**		**2.26**
Q50	91.2%		47.7%	**9.97**		**7.70**
Q20	107.0%		51.7%	**15.25**		**11.18**

Power January	E	S30	MCS	F
Q80	-0.526	0.209	-1.33	0.485
Q50	-1.55	0.468	-1.41	0.548
Q20	-3.85	1.02	-1.49	0.705

January		E	S30	MCS	F	Flow
Q.80=	1.16E+03	4.12E-01	1.45423171	0.005527	1.0	3.84
Q.50=	5.82E+03	7.32E-02	2.31299549	0.004043	1.0	3.99
Q.20=	1.27E+05	1.51E-03	6.21891005	0.002957	1.0	3.54

Standard Error				Flow	Flow		
January				cfs	cfs		
Q80	90.9%	to	-47.6%	**7.33**	**0.52**		
Q50	88.4%		-47.7%	**7.51**	**0.52**		
Q20	89.2%		-51.7%	**6.69**	**0.48**		

Power February	E	S30	MCS	F
Q80	-1.130	0.488	-1.47	0.47
Q50	-3.06	0.939	-1.53	0.548
Q20	-4.06	1.21	-1.56	0.515

February		E	S30	MCS	F	Flow
Q.80=	3.94E+03	1.49E-01	2.39738515	0.003198	1.0	4.49E+00
Q.50=	5.18E+04	5.74E-03	5.37878301	0.002529	1.0	4.04E+00
Q.20=	3.05E+05	1.06E-03	8.74103809	0.002249	1.0	6.37E+00

Standard Error				Flow	Flow
February				cfs	cfs
Q80	88.1%	to	-46.8%	**8.45**	**0.53**
Q50	99.7%		-49.9%	**8.08**	**0.50**
Q20	125.4%		-55.6%	**14.37**	**0.44**

Power	A	E	S30	F

Power	BS	S30	MCS	F

Power	MCS	F	P

March				
Q80	0.922	-1.75	0.354	0.537
Q50	1	-2.97	0.684	0.546
Q20	1.04	-3.59	0.82	0.470

April				
Q80	-3.340	2.8	-1.52	0.795
Q50	-2.12	2.01	-1.55	0.746
Q20	-0.607	1.02	-1.57	0.57

May			
Q80	-1.480	0.817	1.9
Q50	-1.49	0.862	2.13
Q20	-1.43	0.699	2.26

June		A	E	S30	F	Flow
Q.80=	4.10E-01	58.73639	5.2E-02	1.89	1.00	2.37
Q.50=	1.58E+00	82.90000	6.7E-03	3.41	1.00	2.98
Q.20=	6.34E+00	98.92287	2.3E-03	4.35	1.00	6.40

April		BS	S30	MCS	F	Flow
Q.80=	1.17E+04	4.57E-04	150.946658	0.002630	1.0	2.13
Q.50=	9.86E+03	7.59E-03	36.6508468	0.002339	1.0	6.41
Q.20=	7.66E+03	2.47E-01	6.21891005	0.002163	1.0	25.47

July		F	P	Flow
Q.80=	1.28E+00	1	8.93873955	11.44
Q.50=	1.38E+00	1	10.0849131	13.92
Q.20=	1.91E+00	1	6.51452337	12.44

Standard Error				Flow		Flow
March				**cfs**		**cfs**
Q80	131.0%	to	-56.7%	**5.48**		**1.03**
Q50	139.1%		-58.3%	**7.13**		**1.24**
Q20	132.2%		-56.9%	**14.86**		**2.76**

Standard Error				Flow	Flow		
April				**cfs**	**cfs**		
Q80	110.5%	to	-52.5%	**4.48**	**1.01**		
Q50	139.6%		-58.3%	**15.36**	**2.67**		
Q20	161.5%		61.8%	**66.60**	**41.21**		

Standard Error				Flow	Flow
May				**cfs**	**cfs**
Q80	151.5%	to	-60.2%	**28.78**	**4.55**
Q50	180.3%		-64.3%	**39.01**	**4.97**
Q20	163.9%		-62.6%	**32.84**	**4.65**

Table D33 12 Month Discharge Model Deep Creek

Estimated Flows
6th Field HUC
170501 Deep Creek
040603

Area	Area	Mean Basin Elevation	Basin Relief	Slopes >30%		Mean Annual Precip.	Landuse Forested	Basin Slope Average	Distance Total	Distance ^10 & 85%	Elevation Change	Elevation Change ^@10 and 85 %		Main Channel Slope
Acres	Miles	feet	feet	%		in	%	%	miles	miles	meters	feet		ft/miles
273563	427	5526	1920	10		14.9	29	18	38.1	27.3		912		31.92

				A	BS	S30	F	Total Discharge cfs
A=	427	Total Discharge Power						
E=	5.4			0.963	-3.44	2.52	0.646	
BR=	1920			427	18	11	30	
S30=S+1%=	11							
P=	14.9							
F=	30	Qa=	8.37E-01	341.27	0.0000481	421.03	9.00	52.03
BS=	18							
MCS=	31.9							

Power June	MCS	F	P
Q80	-1.46	0.775	1.21
Q50	-1.53	0.844	1.65
Q20	-1.55	0.793	1.9

June		MCS	F	P	Flow
Q.80=	5.47E+01	0.006370118	13.956257	26.28	127.78
Q.50=	3.59E+01	0.004998812	17.64779	86.25	273.15
Q.20=	4.31E+01	0.004664302	14.837378	169.45	505.45

Power July	MCS	F	P
Q80	-1.21	0.587	0.0617
Q50	-1.36	0.698	0.464
Q20	-1.55	0.734	0.876

July		MCS	F	P	Flow
Q.80=	2.66E+02	1.51E-02	7.3632607	1.18	35.03
Q.50=	2.43E+02	9.01E-03	10.740652	3.50	82.33
Q.20=	2.85E+02	4.66E-03	12.139673	10.66	172.01

Power August	MCS	F
Q80	-1.03	0.465
Q50	-1.28	0.57
Q20	-1.39	0.648

August		MCS	F	Flow
Q.80=	1.34E+02	2.82E-02	4.8625198	18.4
Q.50=	4.80E+02	1.19E-02	6.9495889	39.6
Q.20=	9.86E+02	8.12E-03	9.0609675	72.5

Standard Error June				Flow cfs	Flow cfs
Q80	143.7%	to	-59.0%	**311.40**	**52.39**
Q50	165.6%		-62.4%	**725.50**	**443.60**
Q20	167.4%		-62.6%	**1351.56**	**821.86**

Standard Error July				Flow cfs	Flow cfs
Q80	185.6%	to	-65.0%	**100.06**	**12.26**
Q50	155.3%		-60.8%	**210.18**	**32.27**
Q20	140.0%		-58.3%	**412.82**	**71.73**

Standard Error August				Flow cfs	Flow cfs
Q80	214.8%	to	-68.2%	**57.93**	**5.85**
Q50	195.7%		-66.2%	**117.20**	**13.4**
Q20	163.3%		-62.0%	**190.95**	**27.5**

Power September	MCS	F
Q80	-0.992	0.469

Power October	MCS	F
Q80	-1.09	0.432

Power November	MCS	F
Q80	-1.26	0.503

Q50	-1.23	0.503
Q20	-1.36	0.547

Q50	-1.27	0.523
Q20	-1.43	0.598

Q50	-1.36	0.568
Q20	-1.42	0.594

September		MCS	F	Flow
Q.80=	1.10E+02	0.032212429	4.9291254	17.47
Q.50=	3.98E+02	0.014127634	5.533399	31.11
Q.20=	9.48E+02	0.009006339	6.42666	54.87

October		MCS	F	Flow
Q.80=	2.27E+02	2.29E-02	4	22.63
Q.50=	5.77E+02	1.23E-02	6	42.04
Q.20=	1.56E+03	7.07E-03	8	84.28

November		MCS	F	Flow
Q.80=	5.28E+02	1.27E-02	5.533399	37.2
Q.50=	9.89E+02	9.01E-03	6.9024755	61.4
Q.20=	1.71E+03	7.32E-03	7.5406716	94.3

Standard Error				Flow		Flow
September				cfs		cfs
Q80	204.1%	to	-67.1%	**53.11**		**5.75**
Q50	192.2%		-65.8%	**90.91**		**10.64**
Q20	172.3%		-63%	**149.41**		**20.14**

Standard Error				Flow	Flow
October				cfs	cfs
Q80	161.2%	to	-61.7%	**59.12**	**8.67**
Q50	137.8%		-58.0%	**99.96**	**17.66**
Q20	103.6%		50.9%	**171.59**	**127.17**

Standard Error				Flow	Flow
Novemebr				cfs	cfs
Q80	115.9%	to	-53.7%	**80.32**	**17.2**
Q50	99.2%		49.8%	**122.47**	**92.1**
Q20	89.8%		47.3%	**179.06**	**138.9**

Power	MCS	F	P
December			
Q80	-1.26	0.507	
Q50	-1.35	0.565	
Q20	-1.29	0.606	

Power	E	S30	MCS	F
January				
Q80	-0.526	0.209	-1.33	0.485
Q50	-1.55	0.468	-1.41	0.548
Q20	-3.85	1.02	-1.49	0.705

Power	E	S30	MCS	F
February				
Q80	-1.130	0.488	-1.47	0.47
Q50	-3.06	0.939	-1.53	0.548
Q20	-4.06	1.21	-1.56	0.515

December		MCS	F	P	Flow
Q.80=	5.97E+02	0.01273354	5.6091942	1.00	42.64
Q.50=	1.02E+03	0.009323702	6.8324035	1.00	64.98
Q.20=	1.14E+03	0.011477014	7.8548063	1.00	102.77

January		E	S30	MCS	F	Flow
Q.80=	1.16E+03	4.12E-01	1.6506351	0.009992	5.2	41.01
Q.50=	5.82E+03	7.32E-02	3.0716503	0.007574	6.4	63.96
Q.20=	1.27E+05	1.51E-03	11.540391	0.005742	11.0	140.19

February		E	S30	MCS	F	F
Q.80=	3.94E+03	1.49E-01	3.2225497	0.006153	4.9	
Q.50=	5.18E+04	5.74E-03	9.5031532	0.004999	6.4	
Q.20=	3.05E+05	1.06E-03	18.200577	0.004506	5.8	

Standard Error				Flow		Flow
December				cfs		cfs
Q80	91.9%	to	-47.9%	**81.83**		**22.22**
Q50	91.2%		47.7%	**124.24**		**95.97**
Q20	107.0%		51.7%	**212.74**		**155.90**

Standard Error				Flow	Flow
January				cfs	cfs
Q80	90.9%	to	-47.6%	**78.30**	**2.73**
Q50	88.4%		-47.7%	**120.50**	**3.37**
Q20	89.2%		-51.7%	**265.23**	**5.31**

Standard Error				Flow	Flow
February				cfs	cfs
Q80	88.1%	to	-46.8%	**108.10**	**2.63**
Q50	99.7%		-49.9%	**181.88**	**3.23**
Q20	125.4%		-55.6%	**345.37**	**2.56**

Power	A	E	S30	F
March				
Q80	0.922	-1.75	0.354	0.537
Q50	1	-2.97	0.684	0.546
Q20	1.04	-3.59	0.82	0.470

Power	BS	S30	MCS	F
April				
Q80	-3.340	2.8	-1.52	0.795
Q50	-2.12	2.01	-1.55	0.746
Q20	-0.607	1.02	-1.57	0.57

Power	MCS	F	P
May			
Q80	-1.480	0.817	1.9
Q50	-1.49	0.862	2.13
Q20	-1.43	0.699	2.26

March		A	E	S30	F	Flow
Q.80=	4.10E-01	266.22847	5.2E-02	2.34	6.21	82.84
Q.50=	1.58E+00	427.00000	6.7E-03	5.16	6.40	148.83

April		BS	S30	MCS	F	Flow
Q.80=	1.17E+04	6.42E-05	823.94746	0.005175	14.939	47.99
Q.50=	9.86E+03	2.18E-03	123.93652	0.004664	12.6	157.26

May		MCS	F	P	Flow
Q.80=	1.28E+01	5.94E-03	1	9.0885203	116.33
Q.50=	1.38E+01	5.74E-03	1	10.263289	141.63

Q.20=	6.34E+00	544.05774	2.3E-03	7.14	4.95	286.17
Standard Error				**Flow**		**Flow**
March				**cfs**		**cfs**
Q80	131.0%	to	-56.7%	**191.35**		**35.87**
Q50	139.1%		-58.3%	**355.86**		**62.06**
Q20	132.2%		-56.9%	**664.50**		**123.34**

Q.20=	7.66E+03	1.73E-01	11.540391	0.004352	6.9	462.56	
Standard Error				**Flow**	**Flow**		
April				**cfs**	**cfs**		
Q80	110.5%	to	-52.5%	**101.02**	**22.80**		
Q50	139.6%		-58.3%	**376.79**	**65.58**		
Q20	161.5%		61.8%	**1209.58**	**748.42**		

Q.20=	1.91E+01	7.07E-03	1	6.6078047	126.21	
Standard Error					**Flow**	**Flow**
May					**cfs**	**cfs**
Q80	151.5%		to	-60.2%	**292.58**	**46.3**
Q50	180.3%			-64.3%	**397.00**	**50.5**
Q20	163.9%			-62.6%	**333.07**	**47.2**

Appendix E. Photos

Figure E1. Shoofly Creek at Bybee Reservoir Release. August 2000.

Figure E2. Shoofly Creek Upstream of Bybee Reservoir. August 2000.

Figure E3. Nickel Creek Downstream of Springs. June 2001.

Figure E4. Deep Creek (DC-001) Near Mud Flat Road. August 2001.

Figure E5. Red Canyon Creek. at Road Crossing. June 2000.

Figure E6. Red Canyon Creek. Below Road Crossing. June 2000.

Figure E7. Deep Creek near Castle Creek. June 2000.

Figure E8. Red Canyon Creek Near Road Crossing. August 2000.

Figure E9. Redband Trout Mortality, Deep Creek Upstream of Castle Creek. June 2000.

Figure E10. Long Glide Area on Deep Creek, Upstream of Castle Creek. June 2000.

Figure E11. Castle Creek Near Confluence with Deep Creek. June 2000.

Figure E12. Riffle Area on Deep Creek below Glide, Near Castle Creek. June 2000.

Figure E13. Pole Creek Near Mud Flat Road. June 2000.

Appendix F. Distribution List

Upper Owyhee Mailing List

PETE SINCLAIR
NRCS
19 REICH
MARSING ID 83639

LOWELL MURDOCK
IDAHO DEPARTMENT OF LAND
8355 W STATE ST
BOISE ID 83703

BRENDA RICHARDS
OWYHEE CO. NATURAL RESOURCE COMMITT
HC 88 BOX 1090
MURPHY ID 83650

BRUNEAU RIVER
SOIL CONSERVATION DIST.
P.O.167
345 MAIN ST.
GRANVIEW, ID 83624

JOHN CRUM
SHOSHONE-PIAUTE TRIBES
PO BOX 219
OWYHEE NV 89832

JOSEPH PARKINSON
123 W HIGHLAND VIEW DR
BOISE ID 83702

JIM DESMOND
OWYHEE COUNTY COMMISSIONERS
PO BOX 370
MURPHY ID 83650

TIM LOWERY
OWYHEE COUNTY NATURAL RESOURSE
COMMITTEE
BOX 132
JORDAN VALLEY OR 97910

LARRY W. MEREDITH
26190 MOONGLOW
MIDDLETON ID 83644

JEANNIE STANFORD
STANFORD LAND & CATTLE
CLIFFS STAGE
JORDAN VALLEY OR 97910

RIDDLE RANCHES
HC 86, BOX 37
BRUNEAU, ID 83604

GLENNS FERRY GRAZING ASSOCIATION
C/O NICK PASCOE, PRESIDENT
P.O. BOX 126
JORDAN VALLEY, OR 97910

J.R. SIMPLOT COMPANY
HC 85, BOX 275
GRANDVIEW, ID 83624

NAHAS, R.T. COMPANY
C/O CRAIG BAKER
P.O. BOX 127
MURPHY, ID 83650

PENTAN COMPANY OF NEVADA, INC.
HC 32, BOX 450
TUSCARORA, NV 89837

BRUNEAU CATTLE COMPANY
ATTN: ERIC DAVIS
HC 85, BOX 138
BRUNEAU, ID 83604

OWYHEE COUNTY
NATURAL RESOURCES COMMITTEE
P.O. BOX 370
MURPHY, IDAHO 83650

JOHN BARRINGER
6016 PIERCE PARK LANE
BOISE, IDAHO 83706

IDAHO RIVERS UNITED
2600 ROSE HILL
BOISE, IDAHO 83705

IDAHO CONSERVATION LEAGUE
P.O. BOX 844
BOISE, IDAHO 83701

COMMITTEE FOR THE HIGH DESERT
P.O. BOX 2863
BOISE, IDAHO 83701

WILDERNESS SOCIETY
2600 ROSE HILL
BOISE, IDAHO 83705

IDAHO DEPARTMENT OF FISH AND GAME
3101 SOUTH POLELINE ROAD
NAMPA, IDAHO 83686

OWYHEE SOIL CONSERVATION DISTRICT
P.O. BOX 486
19 REICH STREET
MARRING, IDAHO 83639

OREGON DIVISION OF STATE LANDS
A.K. MAJORS EMPIRE COOPERATE PARK
SUITE B-1
BEND, OREGON 97701

WESTERN WATERSHED PROJECT
P.O. BOX 1602
HAILEY, IDAHO 83333

IDAHO DEPARTMENT OF AGRICULTURE
PATRICK TAKASUGI, DIRECTOR
P.O. BOX 790
BOISE, IDAHO 83701

US ENVIRONMENTAL PROTECTION AGENCY
1440 NORTH ORCHARD
BOISE, IDAHO 83706

US DEPARTMENT OF INTERIOR
BUREAU OF LAND MANAGEMENT
LOWER SNAKE RIVER DISTRICT OFFICE
3833 SOUTH DEVELOPMENTAL WAY
BOISE, IDAHO 83705

TREASURE VALLEY TRAIL MACHINE
ASSOCIATION
P.O. BOX 1913
BOISE, IDAHO 83701

IDAHO DEPARTMENT OF LANDS
WINSTON WIGGINS, DIRECTOR
954 WEST JEFFERSON
BOISE, IDAHO 83702

AMERICAN WHITEWATER ASSOCIATION
JOHN GANGENI
482 ELECTRIC AVENUE
BIG FORK, MONTANA 59911

THE NATURE CONSERVANCY
1109 MAIN STREET
BOISE, IDAHO 83702

US DEPARTMENT OF INTERIOR
BUREAU OF LAND MANAGEMENT
OWYHEE RESOURCE AREA OFFICE
3833 SOUTH DEVELOPMENTAL WAY
BOISE, IDAHO 83705

IDAHO DEPARTMENT OF LANDS
SOUTHWEST AREA OFFICE
8355 WEST STATE STREET
BOISE, IDAHO 83703

OWYHEE COUNTY COMMISSIONERS
P.O. BOX 370
MURPHY, IDAHO 83650

US DEPARTMENT OF INTERIOR
BUREAU OF LAND MANAGEMENT
STATE OFFICE
1387 VINNELL WAY
BOISE, IDAHO 83709

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY
1712 SOUTHWEST ELEVENTH AVENUE
PORTLAND, OREGON 97201

Appendix G. Public Comments

Comments From: Petan Ranches Received via FAX: November, 22, 2002 Received via United States Postal Service: November 25, 2002	**Response:**
1) Is the SBA-TMDL a draft or final document? Your letter of October 21, 2002 indicates that the SBA-TMDL is in the "draft" stage of development, and gives an Idaho DEQ web-address where the SBA-TMDL can be viewed. However, the October 2, 2002 SBA-TMDL document for the Upper Owyhee Watershed at the DEQ web-site states on its face that it is a Final Draft. The wed-site document was the only one available to us and was reviewed for this response. However, the question about the status of the SBA-TMDL made it unclear if we were invited to comment on the SBA-TMDL in its entirety, or just upon the SBA-TMDL findings and conclusions, we comment upon it in its entirety, including it findings, conclusions, and proposed actions. **2) Does turbidity in Juniper Basin Reservoir exceed Idaho's WQS?** The SBA-TMDL claims that trubidity in Juniper Basin Reservoir exceeded Idaho's WQS on page xix of its Executive Summary and on pages 61 and 95 of the report. However, the SBA-TMDL does not report any actual measured turbidity values for Juniper Basin Reservoir, or even summarize such measurements. It should provide at least a numeric summary of the turbidity data that was collected. The turbidity WQS for Cold Water Aquatics is premised upon not exceeding <u>background levels</u> by either 50 NTUs instantaneously or 25 NTUs over a period of ten consecutive days (see October 2002 Idaho Administrative Code fir DEQ at IDAPA' 58.01.02.250.02.e, and SBA-TMDL pages 59 and 94). Thus, the Idaho turbidity WQS for Cold Water Aquatics must be evaluated in terms of how much it exceeds background levels. The SBA-TMDL does not determine, nor even discuss, background turbidity levels for Juniper Basin Reservoir. No conclusion can be drawn regarding whether or not Juniper Basin Reservoir exceeded Idaho WQS for turbidity until background turbidity until background turbidity levels are determined. See item 3) below for a discussion of background turbidity levels that are relevant to	The document is a final draft. This implies that comments on the document will be reviewed with applicable comments addressed, changes made in the document, or further explanation made to clarify. Tables have been added to the document in Section 2.4 to discuss in-reservoir turbidity data. The discussion on the exceedance of the turbidity criteria has been modifies to address the narrative sediment criteria. The turbidity levels set in the TMDL are targets. This reference to the water quality standards for turbidity will be omitted in the final submittal document. These standards relate to point source wastewater discharges. With this in mind, background concentrations are not applicable. The Idaho WQS for sediment prohibit sediment in quantities that impair the beneficial uses for the water body. An independent analysis of periphyton (Bahls 2001) showed severe impairment to the biological community in both Juniper Basin and Blue Creek Reservoirs. As discussed above, the turbidity levels set in the TMDL are targets. This reference to the water quality standards for turbidity will be omitted in the final submittal document. These standards relate to point source wastewater discharges. With this in mind, background concentrations are not applicable.

Juniper Basin Reservoir. **3) Is the background turbidity for Juniper Basin Reservoir 0 NTUs?** The SBA-TMDL concludes on page 100 that the total turbidity Load Capacities for reservoirs are 25 NTUs over ten consecutive days or 50 NTUs instantaneously. The SBA-TMDL lists these same Load Capacities for Juniper Basin Reservoir in Table 31 on page 101. The Juniper Basin Reservoir of 22.5 NTUs or 45 NTUs respectively on Pages 108-109. Consequently, the SBA-TMDL turbidity Load Capacities and Load Allocations are based upon the assumption that the background turbidity for the reservoirs is 0 NTUs. Interestingly, the SBA-TMDL acknowledges that it was developed despite a lack of data and knowledge regarding existing sediment loads on pages 105-106. Furthermore, the SBA-TMDL acknowledges that there was no data available to assess the status of existing uses for Juniper Basin Reservoir on pages xix, 42 and 44.	Table 39 shows the load capacity, or targets, for both Juniper Basin Reservoir and Blue Creek Reservoir. The reference to background levels located in Table 27 will be omitted in the final submitted SBA-TMDL. Background turbidity levels are discussed in Section 2.4.
Petan contends that the background turbidity level for Juniper Basin Reservoir must be established before determinations of the Load Capacity for turbidity and associated Load Allocations can properly be made. Turbidity data to determine background turbidity levels associated with Blue Creek Reservoir are available bases upon turbidity monitoring conducted by Western Range Services (WRS) for Riddle Ranches, Inc. Such data demonstrates that the assumption of a 0 NTU background turbidity for Blue Creek Reservoir from 1999 through 2002. Analysis of the turbidity is about 25 NTUs in the late spring. 16 NTUs in mid summer and 7 NTUs in the fall (see Riddle Ranches, Inc.'s comment letter dated November 22, 2002). Similar background turbidity determinations should be made for Juniper Basin Reservoir.	As discussed above, the turbidity levels set in the TMDL are targets. This reference to the water quality standards for turbidity will be omitted in the final submittal document. These standards relate to point source wastewater discharges. With this in mind, background concentrations are not applicable.
The erosion K-Factors depicted in Figure 11 on page 83 of the SBA-TMDL show that the soils in the vicinity of Juniper Basin Reservoir are generally more erodable then those in the vicinity of Blue Creek Reservoir. Therefore, Petan expects that the background turbidity associated with Juniper Basin Reservoir is at least as high as that associated with Blue Creek Reservoir. Therefore, appropriate instantaneous Load Capacities for Juniper Basin Reservoir can reasonable be expected to be at least 75 NTUs in late spring, 66 NTUs in mid summer and 57 NTUs in fall. Also, appropriate ten-consecutive-day Load Capacities for Juniper Basin Reservoir can reasonable be expected to be at least 50 NTUs in late spring, 41 NTUs in mid summer and 32 NTUs in fall. We therefore contend that subsequent Load Allocations for turbidity need to	See response above.

be recalculated based upon the above Load Capacities.	
Furthermore, the Margin of Safety (MOS) used for sediment in the SBA-TMDL is primarily based upon two unknowns; existing loads and current streambank erosion rates (see SBA-TMDL page 105). The determination of background turbidity levels in the above analysis helps to answer the first unknown. Therefore, the MOS for the Load Allocations should be reduced by at least half when they are recalculated.	See responses to pervious comment.
Finally, the estimated bank erosion rates for Juniper Creek shown in Table 34 (page 103 of the SBA-TMDL) are from 63 to 1,038 times greater than the target bank erosion rate shown in Table 31 (page 101). It is inconceivable to Petan that current or historic land uses could account for this magnitude of difference, particularly in light of the fact that ecological status of the associated watershed was found to be late-seral in both 1979 and 1997 meeting and going beyond BLM's Land Use Plan requirements for range conditions and trend. The target erosion rates, or the estimated erosion rates, or both, are unrealistic and should be reconsidered.	The values represented in Table 34 are gross estimates based on a streambank study conducted in an adjacent watershed with similar characteristics. The TMDL clearly states as more information is collected by land management agencies these values will be adjusted to reflect any further findings.
4) Should creeks that often go dry be required to meet temperature and turbidity standards for Cold Water Aquatics? Petan contends they should not, and contends that such creeks, including Juniper Creek, should not include Cold Water Aquatics on their lists of beneficial or existing uses. Information presented in the SBA-TMDL indicates that many of the Upper Owyhee Watershed streams currently on Idaho's "303(d)" list were found to be dry during at least some of the field monitoring conducted by the Idaho DEQ. Some of these creeks were found to be dry for a period of time in each year that monitoring was conducted by the Idaho DEQ. It is unreasonable to require that these steams achieve temperature and turbidity WQSs fir Cold Water Aquatics when the fact that they are often dry in the most significant factor limiting cold water species. Instead, the finding that these streams are often dry should be used to support a determination that Cold Water Aquatics is not a beneficial or existing use that these creeks are required to support.	**Intermittent Waters.** A stream, reach, or water body which has a period of zero (0) flow for atleast one (1) week during most years. Where flow records are available, a stream with a 7Q2 hydrologically-based flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with natural perennial pools containing significant aquatic life uses are not intermittent (IDAPD §58.01.02.003.53). Since there are no historic flow data in the Upper Owyhee Watershed, streams were classified as intermittent based on USGS Topographic maps. Numeric water quality standards only apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated (IDAPA §58.01.02.070.06).
5) Are the SBA-TMDL temperature targets and estimated shade requirements reasonable? Petan contends that they are not, and contends that alternative reasonable levels that can be attained should be established.	Several streams in the watershed are included in the Idaho Department of Fish and Game's Fisheries Management Plan as managed for wild stocks of redband trout (cold water aquatic life). With this

The SBA_TMDL estimates that the amount of shade required to achieve target temperature Load Capacities is often near 100% in Table 29 on page 99. In fact, the June estimates are all 87% or higher. Such high shade requirements are virtually unattainable everywhere along the stream segments listed in the SBA-TMDL. Since the shade requirements to achieve current target temperatures are unattainable, the current temperature targets are unattainable and unreasonable. The temperature targets need to be changed so that they are reasonable and attainable.	information in mind, as well as temperature data which showed violations of the WQS for temperature, such streams must be proposed for placement on the Idaho §303(d) list. If data exists which indicates that any of the streams we have proposed for the §303(d) list are in compliance with cold water aquatic life temperature standards, DEQ encourages public input with data to support this position during the §303(d) listing process. Whether or not the cold water aquatic life temperature standard is attainable or not was not within the scope of this SBA-TMDL. This type of decision can only be made upon completion of a Use Attainability Analysis (UAA).
Petan reserves the right to provide comments and input during the anticipated development of implementation and monitoring plans that will affect their livestock operation (see SBA-TMDL pages xxviii and xxix). We wish to forecast for you that Juniper Basin Reservoir is an irrigation reservoir authorized under federal grant(s). Petan Company of Nevada, Inc.	Comments noted.

Comments From: Thomas G. Skinner Received November 26, 2002	Response
I was one of the Jordan Valley livestock operators in the late 1940's. My livelihood extended into the designated area for fishing and hunting, besides riding the nearby ranges for stray cattle.	Comments noted
I was warned that I should not fish the small streams that emptied into the North Fork of Owyhee and Deep Creek after July 1. They go dry in the summer. I was warned to not fish Deep Creek in the summer as it is almost level and is hot and mossy.	Comments noted.
I am not a member of the Owyhee County Natural Resource Committee.	Comments noted.
The subject of constructing a model for this assessment process may be another bureaucratic agency program but it must contain local participation for its implementation. The plan resulting from IDEA's data collection on Pole Creek, Red Canyon, Castle Creek and Nickel Creek is questionable because of the water temperature on these small streams during late summer months.	The SSTEMP model has been used a variety of TMDLs (Rio Chamita, New Mexico; Upper Ponil Creek, New Mexico; Navarro River, California). The Ponil Creek and Rio Chamita TMDLs were the templates and format for the Upper Owyhee Watershed TMDL. All TMDLs mentioned are approved TMDL, and thus DEQ believes the model use is an appropriate technique as described in 40 CFR 130.2(g). If the commenter wishes to provide any data that would clearly dispute the use of the SSTEMP model it maybe considered in an amendment to the Upper Owyhee Watershed SBA-TMDL. Current WQS and the SBA – TMDL for these streams are based on cold water aquatic life. In order to change these standards to something less stringent a use attainability analysis (UAA) would be required.
I suggest that the federal land management agencies refrain from eliminating uses rather than collecting and analyzing the data for a plan to assist in decisions for managing the in-place allocations.	All interested stakeholders will be involved in developing an implementation plan.

Comments Received From: Idaho Soil Conservation Commission Received via: United States Postal Service: November 22, 2002	Response Date: November 29, 2002
On the basis of a thorough review by Commission staff and discussion with the SSTEMP developer, there are some concerns that need to be addressed regarding the process of developing this TMDL, and the use of shading and bank width as a surrogate for the temperature TMDL, and the use of another watershed streambank erosion raters from another watershed to allocate the sediment load allocation. Regarding the use of the SSTEMP model, there is concern with its use in setting TMDL temperature load allocations. SSTEMP was developed to be used as an "exploratory" tool a land manager uses to help determine alternation solutions to improving riparian and stream temperature conditions. SSTEMP should not be used in this case to set TMDL load allocations, prescribing land management targets, such as 100% shading on specific tributaries within the watershed. While increased shading and decreased stream widths may be feasible to achieve in some areas of this watershed, it is not appropriate for the entire stream length due to stream morphology variations, hydrologic limitations, and vegetative growth capabilities. The Commission feels that prescribing specific "practices" to meet beneficial uses should not be done within the TMDL but within the context of a watershed implementation plan. While SSTEMP can, with good quality and an adequate quantity of input data, faithfully reproduce mean daily water temperatures throughout a stream reach. (Bartholow, SSTEMP 2002), its capability for accurately predicting maximum daily temperatures is (questionable?) Added by DEQ for clarity. (Bartholow – phone conversation Oct. 30, 2002). SSTEMP is not to be used as a predictor of actual temperatures, but as a tool to compare changes in	Comments noted, and will be addressed. The SSTEMP model has been used a variety of TMDLs (Rio Chamita, New Mexico; Upper Ponil Creek, New Mexico; Navarro River, California). The Ponil Creek and Rio Chamita TMDLs were the templates and format for the Upper Owyhee Watershed TMDL. All TMDLs mentioned are approved, and thus DEQ believes the model use is an appropriate technique as described in 40 CFR 130.2(g). If the commenter wishes to provide any data that would clearly dispute the use of the SSTEMP model it may be considered in an amendment to the Upper Owyhee Watershed SBA-TMDL. The validation of the model located in Appendix D shows the actual water temperature data gathered in 2000 and 2001 and the predicted temperature provided by SSTEMP showed a strong validation of the model use for both maximum daily average temperature and maximum daily temperature. It is clearly stated in the model calibration and validation portion of Appendix D that the maximum daily temperatures are predicted only. The SSTEMP model has been used a variety of TMDLs (Rio Chamita, New Mexico; Upper Ponil Creek, New Mexico; Navarro River, California). The Ponil Creek and Rio Chamita TMDLs were the templates and format for the Upper Owyhee Watershed TMDL, this included the prediction of maximum daily temperature. All TMDLs mentioned are approved, and thus DEQ believes the model use is an appropriate technique as described in 40 CFR 130.2(g). If the commenter wishes to provide any data that would clearly dispute the use of the SSTEMP model it maybe considered in an amendment to the Upper Owyhee Watershed SBA-TMDL. 40 FCR 130.2(g) states, " Load allocations are best estimates of the loading, which may range from reasonable accurate estimates to gross allotments,

attributes. Maximum temperatures are least likely correct when derived from the model (Bartholow – phone conservation Oct. 30, 2002). Average temperatures are better predicted. Also SSTEMP requires more accuracy when utilizing the model to prescribe riparian vegetation manipulation. Data obtained from multiple sites within a reach is absolutely necessary when inputting the optional shading variables. The number of BURP or other data collection sites is too limited to provide any level of accurately describe current conditions within the steam reaches.	depending on the availability of data and appropriate techniques for predicting loading." If the author of SSTEMP wishes to provide direct comments concerning the use of his model, those comments may be considered for amendments to the Upper Owyhee Watershed SBA-TMDL. The SSTEMP model has been used for a variety of TMDLs (Rio Chamita, New Mexico; Upper Ponil Creek, New Mexico; Navarro River, California). The Ponil Creek and Rio Chamita TMDLs were the templates and format for the Upper Owyhee Watershed TMDL, this included the prediction of maximum daily temperature. All TMDLs mentioned are approved, and thus DEQ believes the model use is an appropriate technique as described in 40 CFR 130.2(g). If the commenter wishes to provide any data that would clearly dispute the use of the SSTEMP model it maybe considered in an amendment to the Upper Owyhee Watershed SBA-TMDL.
The apparent lack of stream flow, ground water flow, or temperature data, as well as no local watershed based climatic data (such as humidity, air flow, etc.) and stream physical attributes data (such as wetted width), indicates the attempted use of this model would likely result in gross misinterpretations of existing conditions and resultant predictions through various adjustments in model inputs.	40 CFR 130.2(g) states, " Load allocations are best estimates of the loading, which may range from reasonable accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading." If the commenter wishes to provide any data that would clearly dispute the use of the SSTEMP model it maybe considered in an amendment to the Upper Owyhee Watershed SBA-TMDL. In May 2000, DEQ requested any information and data for the Upper Owyhee Watershed SBA-TMDL development. DEQ did not receive any response from the commenter. The information stated in the comments may or may not have provided further information for the model calibration. 1. Estimates of stream flow were obtained from a hydrologic model developed by the United States Geological Survey and United States Forest Service with specific application to Idaho (Hortness and Berenbrock, 2001). 2. No data was provided to DEQ that would identify ground water aquifers in the area. Ground water input is not a required input parameter for model runs. 3. Surface water temperature was provided in the document. 4. There are no climate stations in the watershed.

	5. The stream's physical attributes were analyzed using available data. If other stream channel attributes are available, DEQ is willing to consider that data for an amendment to the Upper Owyhee Watershed SBA-TMDL. The validation of the model located in Appendix D shows the actual water temperature data gathered in 2000 and 2001 and the predicted temperature provided by SSTEMP showed a strong validation of the model use for both maximum daily average temperature and maximum daily temperature.
Also, SSTEMP does not automatically handle cumulative effects (Bartholow 2002). Changing only stream shading, "mathematically adding or deleting vegetation is not the same as doing so in real life, where such vegetation may have subtle or not so subtle effects on channel width and length, air temperature, relative humidity, wind speed, and so on" (Bartholow 2002). If one chooses to utilize SSTEMP to prescribe changes in shading, then one must also adjust the other variables that will change along with an increase of vegetation to provide a more accurate prediction.	The SSTEMP model has been used for a variety of TMDLs (Rio Chamita, New Mexico; Upper Ponil Creek, New Mexico; Navarro River, California). The Ponil Creek and Rio Chamita TMDLs were the templates and format for the Upper Owyhee Watershed TMDL, this included the prediction of maximum daily temperature. All TMDLs mentioned are approved, and thus DEQ believes the model use is an appropriate technique as described in 40 CFR 130.2(g). If the commenter wishes to provide any data that would clearly dispute the use of the SSTEMP model it maybe considered in an amendment to the Upper Owyhee Watershed SBA-TMDL.
If the TMDL load allocation process, as outlined in the draft TMDL, is to be based on a "quantity" target for temperature, while utilizing the SSTEMP model, it should be limited to setting a mass/unit/time measurement of heat in joules/meter^2/second (Utilize Table 28, p. 98). The joules/ meter^2/second, would not infer specific stream manipulation to meet the temperature target, such as shading. The Commission recommends that Table 29 "Shade Requirements to Achieve Load Capacity for Stream Segments in Upper Owyhee Watershed" be removed from the TMDL document and that load allocations be, at most, based on Table 28, SSTEMP's joules/ meter^2/second output. Land management agencies and landowners should be allowed to determine (in the near future) what Best Management Practices are best suited to meet and support beneficial uses.	Table 28 provides the mass/unit/tame requirement for a TMDL. The measurement of joules/meter^2/second is the link for the surrogate measurement of the required percent shade to achieve the State WQS.
Regarding the Upper Owyhee sediment TMDL portion, there are also some concerns. The wide range of lateral recession rates previously estimated for the Succor Creek watershed should not be used as an example for determining this watershed's sediment TMDL load. The differences in morphological, hydrological, and other physical characteristics as well as other data in these two	This is the only available data that would offer some comparison. The streambank erosion rates for Succor Creek were placed in the document only to demonstrate the variability of streambank erosion associated with the arid deserts in southwest Idaho. In the same section the document reads, "As more streambank information is collected by land management agencies the values in Table 34 will be adjusted." If there are other streambank erosion

watersheds is too significant to provide accurate determination of the sediment load.	rates available that has specific application to the Upper Owyhee Watershed, it may be considered for an amendment to the Upper Owyhee Watershed SBA-TMDL.
Utilizing data on stream bottom percent fines may be the most appropriate choice to set sediment targets, even though data is limited to a small number of BURP sites.	Comments noted.
The allocation method, in which where rangeland is deemed the largest contributor of sediment, would not be appropriate unless delivery ratios have been established. According to DEQ, streambank erosion allocations (Table 42) are expected to meet in-stream TMDL targets, then upland load allocations (Tables 37, 38) would not be necessary. The sediment target load allocations on rangeland and in-stream bank erosion discussion is not clear.	Streambank erosion rates are targets that will achieve the in-stream sediment load. With no data except for those provided by the BLM through the use of the MUSLE model, it is very difficult to determine the delivery rate to water bodies. 40 CFR 130.2(g) states, “ Load allocations are best estimates of the loading, which may range from reasonable accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading.” If the commenter wishes to provide any data that would assist in determining the delivery rates from up-land erosion it maybe considered in an amendment to the Upper Owyhee Watershed SBA-TMDL.
If riparian areas are lumped in with rangeland for assigning the temperature load allocation, would it not seem appropriate that the same logic apply to the sediment allocations? Does this TMDL require meeting upland (rangeland) erosion allocation and in-stream bank erosion rate or just one of the two?	Table 36 will be corrected to show the total heat load will be assigned to rangeland.

Comments From: Idaho Department of Agriculture Received via Fax Copy; November 20, 2002 Letter Dated November 12, 2002	Response November 21, 2002
We are concerned with the use of the SSTEMP model for establishing temperature loads within the Upper Owyhee system. We are submitting the following comments. Our comments also reference the letter submitted by the Soil Conservation Commission (SCC)(Jerry Nicolescu, October 30, 2002). Our concerns are similar to the SCC concerns about stream flow model being used to predict minimum stream flows along with loads for sediment within the Owyhee System. As stated on page 101, Section 5.3 Estimating of Existing Pollutant Load. Regulations allow that loading "may range from reasonable accurate estimates to gross allotments depending on the available data and the appropriate techniques for predicting the loading (40 CFR § 130.2(I)). The key words in this comment are appropriate techniques, which ISDA feels is not available for this loading analysis. Also this quote could not be located within the referenced CFR.	Comments noted and will be addressed in the response to comments received from the Idaho Soil Conservation Commission. The citation should read CFR §130.2 (g) and will be corrected in the Upper Owyhee Watershed SBA-TMDL document. The use of the mentioned hydrologic model is a peer-reviewed document. The model and the corresponding document clearly state the limitations of the document. However, it is DEQ's belief that the use of the streamflow model is an appropriate technique. It is recognized that the model has limitations. Through a literature search, it was determined that this flow model is the only model with specific application to this area in the state of Idaho. If there is another hydrologic model available or data to assist in validating the model runs that has a specific application to the Upper Owyhee Watershed, it may be considered for an amendment to the Upper Owyhee Watershed SBA-TMDL.
A TMDL is a legal document that applies those pollutant load reductions requirements on water bodies. A TMDL whether on public, private, state or federal lands require these reductions be met by implementing BMP activity within the TMDL watershed. These reductions should not be gross allotments or developed with models that do not distribute a fair reduction allocation to property owners. Unfortunately, the stream flow model that was used for load allocations does not function well for the Owyhee area (Region 7). The author of the model states, "Although the SEE of estimating equations for regions 6 and 7 generally were significantly larger than those for other regions, the natural variability of streamflow in regions 6 and 7 is also significantly greater in the other regions as a result of more sporadic and generally less precipitation (Mounau 1995). Prediction of streamflow statistics that have a high degree of variability will have more uncertainty than	It is agreed that the flow model used has limitations, especially for sections in southwest Idaho. An effort was made to validate the model for the Upper Owyhee Watershed. However, without some long term, or even short term, historic flow data this proved impossible. A comparison with this watershed to other watersheds in surrounding HUCs was attempted. This also proved to be extremely difficult because lack of similar physical and meteorological characteristics (i.e. elevation changes, drainage areas, land use, precipitation) between paired watersheds. If there is another hydrologic model available that has a specific application to the Upper Owyhee Watershed, it may be considered for an amendment to the Upper Owyhee Watershed SBA-TMDL.

prediction of statistics that are more stable." In addition, the models reliability and limitations might not be reliable for sites where the basin characteristics are outside the range of characteristics that were used to develop the equations (table 11 within model document). The model also states that the using basin characteristic values near their extremes (maximum or minimum table 11) might result in unreliable and erroneous estimates. It was not well defined within the TMDL document which model input parameters were utilized. If the input parameters are near the extremes, as stated in the model, then when other input values are added to the model then the results could be further skewing of the results. An explanation of the model use and validation is not located in Appendix D as stated in the TMDL document.	It is agreed that some of the watershed's physical characteristic parameters were usually less than the minimum extremes, mainly basin relief values. However, the input value for basin relief was not used in the calculations to determine the flows. As an example: For Juniper Basin, the only input parameters that would have been below the minimum value to put into the model were basin relief (BR). This value was not used for any of the flow calculations for any months where estimated flows were calculated. The model's documentation's states, …the equations might not be reliable for sites where the basin characteristics are outside the range of characteristics that were used to develop the equations." The documentation also states, "Using basin characteristics values near the extremes might result in unreliable and erroneous estimates. DEQ recognizes that Appendix D did not contain all the information. On discovering this error, a copy of the model spreadsheets was electronically sent to the commenter's agency.
Another concern with the USGS model has to do with estimating the low streamflow statistics (80 percent exceedance) that are used to predict loads within the Owyhee watershed. In general, the equations are more reliable for estimating high streamflow statistics (20 percent exceedance) than estimating low streamflow statistics (80 percent exceedance in any given month). It appears from the author's comments that the degree of error is much larger when using this model in Idaho Region 7 and with the Q.80 flow estimates. Considering the large standard estimated error (SEE) shown in Table 9 of the model, for June, July and August, it appears that this model will be ineffective in accurately predicting discharge rates and load allocation for the Upper Owyhee TMDL.	The Q.80 value obtained by the model was used to determine the critical conditions. It is agreed that the flow model used has limitations, especially for sections in southwest Idaho. If there is another hydrologic model available or available flow data that has a specific application to the Upper Owyhee Watershed, it may be considered for an amendment to the Upper Owyhee Watershed SBA-TMDL.
The values found in Table 34 of the TMDL document are based on streambank erosion rates that where identified for Succor Creek in southwest Idaho. The erosion rate of 13.04 to 214.8 tons/mile/year (Horsburgh) was used for estimating bank erosion rates for the Upper Owyhee watershed. Are these two watersheds that identical in hydrology and geology to allow estimated erosion rates from Succor Creek watershed to be transferred to the Upper Owyhee watershed? An erosion rate of 13 to 215 tons/mile/year seems to have a very high level of uncertainty for estimating bank erosion rates. Table 34 lists the methods of erosion	This is the only available data that would offer some comparison. The streambank erosion rates for Succor Creek were placed in the document only to demonstrate the variability of streambank erosion associated with the arid deserts in southwest Idaho. In the same section the document reads, "As more streambank information is collected by land management agencies the values in Table 34 will be adjusted." If there is other streambank erosion rates available and has a specific application to the Upper Owyhee Watershed, it may be considered for an amendment to the Upper Owyhee Watershed SBA-TMDL.

estimation based on probable bank erosion yields 18214 tons/mile. Where did these numbers come from?	The reference to the 18214 (18-214) figure is a typo error. The value should be the 13-214 tons/mile value stated on the previous page in reference to the Succor Creek study. This will be corrected for the final document.
Overall this TMDL is fully of estimations based on uncertain modeling with no real data to base any of the loading assumptions on. When models are used they require solid data inputs to insure the model projections are within the parameters of the real world. Without solid data the validation of the model is impossible and overall results are not scientifically valid. It is unfortunate that the Upper Owyhee TMDL cannot be delayed until real data is available to formulate a proper TMDL load for temperature and sediment. Without solid load reduction numbers it will nearly impossible for land management agencies and private property owners to install proper BMPs to reach the goal of the Clean Water Act.	40 CFR 130.2(g) states, "Load allocations are best estimates of loading, which may range from reasonable accurate measurements to gross allocations, depending on the availability of data and appropriate techniques for predicting the loading." With the resources and timeframe available to develop this TMDL, DEQ believes that appropriate techniques were used to determine load allocations for the Upper Owyhee Watershed. As stated through out the TMDL portion of the document, the values presented are gross estimates and as more information is collected then modifications to the TMDL will occur and values may be amended.

Comments From: Committee for the High Desert and Western Watershed Project Received via E-mail; 11-10-02	Response: 11-15-02
The document suffers from glaring omissions, and a lack of solid data for decision making on many components of the Assessment/TMDL process. We refer to you to a large array of data collected by BLM in the Nickel Creek, Trout Creek, Castlehead-Lambert, Bull Basin and other Fundamentals of Rangeland Health determinations and grazing assessments that document widespread ongoing harmful livestock grazing impacts to the watersheds covered in this EA. You primarily discuss BLM fish data in the DEQ report. You must include the overwhelming body of evidence in these BLM documents that point directly to livestock grazing as the cause of watershed-level devastation here. For ALL data discussed or analyzed in your assessment, please provide information on whether livestock grazing was occurring during the period when the data was collected. Sediment - You have not examined these streams during periods of the year when they are chock-full of sediment, and the water is muddy brown. You complain that these lands are inaccessible û yet the Mud Flat road is often drivable in March, and certainly in April. We have specifically told you in other TMDL processes that to adequately assess sediment, you need to examine sediment at that time, not during low flows in mid-summer, or during summer periods before livestock are grazing in an area. Of particular interest to you should be the BLM data that shows ongoing failures by the livestock industry in nearly all Owyhee grazing allotments to meet stubble height and trampling objectives. Stubble heights were put in place to protect ongoing IRREPARABLE livestock damage to streams. Violations of these court-ordered terms means that streams suffer widespread erosion during runoff periods. This runoff sweeps soils and abundant livestock waste in to waters of the TMDL area. It is essential you examine and collect data on sediment and other pollutants during runoff for all streams where you have determined, based on your inadequate sampling effort, that streams are not being impaired by sediment.	Comments noted. The Bureau of Land Management's (BLM) Environmental Assessments (EA) mentioned discuss land management objectives which include the overall goals of the Idaho Rangeland Standards and Health Guidelines. One of these goals is the compliance with Idaho Water Quality Standards. However, these EAs offer no new water quality data that will alter the SBA-TMDL conclusions. This type of information is not a component of the monitoring plan (Ingham 2000) and was not documented. Livestock grazing is a land use in the watershed. One of the goals of the SBA was to determine the water quality status with regard to the listed pollutants. The available data was used to establish load reductions where applicable. The state water quality standards have provisions that preclude sediment in quantities, which may impair designated beneficial uses. Improved bank stability and riparian vegetation, as is recommended in the document, will decrease sediment loads during high flow events. The Bureau of Land Management's (BLM) data offer no new water quality data that will alter the SBA-TMDL conclusions. If data becomes available that indicates sediment impairment of streams, DEQ will consider this information for future assessment and TMDLs, if necessary. The BLM has the proper authority to enforce the terms of grazing allotments.

As a simple method of verifying whether there could possibly maybe just might be some severe sediment problems in these watersheds during runoff, we suggest you talk to kayakers who float Deep Creek and the East Fork. Ask them what color the water is. Examine photos they might have taken. Or rent a small plane, and fly over these canyons in spring and photograph the chocolate water.	The only method to determine whether or not aesthetics are meeting the intent of the state water quality standards is through complaints received. To date, we have not received complaints concerning the aesthetic quality of the Upper Owyhee watershed. DEQ encourages public input such as this during the §303(d) listing process.
Your assessment inadequately addresses the role of ephemeral and intermittent streams in carrying sediment and other livestock û caused pollution into the streams assessed. Many of these streams are intermittent only because of livestock damage û and during spring runoff periods carry high volumes of sediment and other pollutants (livestock waste) in their flowing waters.	One of the goals of the SBA was to determine the water quality status with regard to the listed pollutants. The available data was used to establish load reductions where applicable. The state water quality standards have provisions that preclude sediment and bacteria in quantities, which may impair designated beneficial uses. Improved bank stability and riparian vegetation, as is recommended in the document, will decrease sediment loads during high flow events. Based on the available data, bacteria concentrations were not found in violation of state water quality standards.
Your assessment places overwhelming evidence on aquatic organisms as a measure of sediment. These can not be a surrogate for collection of a much broader array of data that needs to be collected under specific EPA and other protocols that have been established for sediment TMDLs.	DEQ’s current policy is to use the Water Body Assessment Guidance II (January 2002) and all other available data. This process is accepted by the EPA for TMDL development. Improved bank stability and riparian vegetation, as is recommended in the document, will improve water quality and restore beneficial uses.
Given the lack of adequate data, we believe it is premature to de-list ANY streams for sediment, and that numerous streams (all tribs., East Fork Owyhee) should be added to the list for sediment and temperature based on the data that you have assembled.	The subbasin assessment (SBA) addresses only the water bodies listed on the 1998 §303(d) List. Based on the available data, several segments were recommended for de-listing because they were not found to be impaired by sediment. If data exists which indicates all tributaries and the Owyhee River are impaired, DEQ encourages public input with data to support this position during the §303(d) listing process.
Bacteria: You have utterly failed to collect adequate bacterial pollution data on all streams in the assessment area. This can only be seen as an attempt by your office to cover up the extreme levels of livestock pollution of springs, seeps and streams in these watersheds. In the North Fork Owyhee TMDL, you collected 3 one point in time bacteria samples INSIDE an exclosure. You have done almost the same thing here--with 3 one point in time samples in Battle Creek, with at least one, and possibly two of the three samples, being located inside an exclosure. This exclosure, that encompasses the confluence of Big Springs and Battle Creeks, is the largest exclosure in the entire	Bacteria sampling was conducted on those water bodies where bacteria was a listed pollutant. Based on the sampling performed, no exceedences were found. Samples were taken in the exclousure area near Twin Bridges as well as below private land at a site know as the Upper Crossing. If data exists which indicates that Battle Creek is impaired by bacteria, DEQ encourages public input with data to support this position during the §303(d) listing process.

Lower Snake River District û and may be the largest official exclosure on any of the 11.8 million acres of Idaho BLM lands. Following this magnificent effort, you proclaim that you are de-listing Battle Creek for bacteria. This must be corrected in the final document, and you cannot de-list Battle Creek for bacteria based on this sapling. In order to properly assess impairment and exceedences for bacteria, you must collect data during the period, and in areas where, livestock, the source of bacterial problems throughout these watersheds, are present. Collection of water samples inside exclosures as a basis for de-listing of streams is inexcusable, unscientific, and reveals the profound livestock industry biases that pervade this assessment/TMDL.	
We request that, before you prepare a Final Assessment/TMDL for these watersheds, you collect bacterial data in all streams. As bacteria and livestock fecal matter can contribute to algal growth, brownness, murkiness and other factors that cause turbidity and sediment impairment, it is essential that you do this - even on streams that have not been listed for bacteria so that you can better understand the contribution of these pollutants.	Additional bacteria monitoring will be conducted with scheduled Beneficial Use Reconnaissance Program (BURP) monitoring. Future monitoring for bacteria will also in all likelihood be an element of the implementation plan for the Upper Owyhee watershed.
Page xv states: “for those streams listed as not supporting primary and secondary contact recreation due to the presence of bacteria, monitoring has indicated those streams are full support.” This statement and conclusion must be stricken from the final report, as it is based on completely insupportable and unscientific methodology as described above.	Bacteria sampling was conducted on those water bodies with bacteria listed as a pollutant of concern. Current bacteria monitoring protocol is to take one sample, and if that sample exceeds the criteria, then additional samples would be required. Since no single sample exceeded the criteria, no additional samples were required (IDEQ 2001). If data exists which indicates streams in the watershed are impaired by bacteria, DEQ encourages public input with data to support this position during the §303(d) listing process.
Aesthetics. We ask that you include an analysis of livestock-caused water quality impacts to all water bodies analyzed in this assessment. We have observed firsthand the disgusting, stinking, polluted waters of each of these streams. While such stench and ugliness may be characteristic of a Caldwell feedlot, it is not appropriate in wild lands, WSAs, ACECs, etc. Your analysis is devoid of a consideration of water quality problems impairing values of WSAs and other nationally significant wild lands here. You repeatedly refer to a reference by Allen et. al. in 1993 that is a study examining redband trout populations and where other stream data û including water quality data was collected. I (Fite) participated in the field work for that study, and can assure you that nearly all locations sampled had wretched water quality -- including abundant	Aesthetic values are protected under the General Surface Water Criteria (58.01.02.200.01.09). The presence of considerable algae growth in Deep Creek initiated a need for dissolved oxygen monitoring. Based on the data collected, dissolved oxygen will be recommended as a pollutant for the next §303(d) listing cycle for Deep Creek. Any other data submitted to DEQ will be evaluated through the Water Body Assessment Guidance to determine support of beneficial uses and future listing on the §303(d) List. To date, we have not received complaints concerning the aesthetic quality of the Upper Owyhee watershed. DEQ encourages public input such as this during the §303(d) listing process.

algae "slime" and manure, and extensive grazing and trampling damage. In all streams I have re-visited in recent years, these conditions persist.	
Page xxiv refers to BLM bacterial samples. Please provide a complete list of all data related to these and any other samples as an appendix in the final TMDL.	Table B on page xxiv is in reference to Bureau of Land Management (BLM) temperature data for Battle Creek. The reference to this data and other BLM temperature data will be listed in the final document in appendix C.
Springs and Seeps. You have failed to include data, as from the 2001 Columbia spotted frog report, that documents ongoing destruction of beaver ponds and many photos that depict widespread grazing damage to wetlands, including springs and seeps and tributary drainages in the assessment areas. We note that springs, seeps and smaller drainages here are critically important to spotted frogs -- yet you have failed to analyze data for any of these in your assessment. It is essential that you do so û as these areas are critical to a broad array of native wildlife and aquatic species, and they are overwhelmingly impacted by livestock grazing damage. Plus, analysis of springs, seeps and intermittent drainages is necessary to understand the temperature and sediment problems that you have documented to be plaguing these watersheds.	Amphibians are recognized in the Water Body Assessment Guidance as aquatic species that will be factored into the assessment of fish populations. If data becomes available that indicates impairment of intermittent streams, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.
Please provide a rationale for your methods (or lack thereof) of data collection here.	DEQ does not currently have a protocol for monitoring springs, seeps and intermittent streams.
We believe the final TMDL, and the next impairment/303(d) list, must include the following drainages for the following water quality impairment/ pollutants: East Fork Owyhee River, Paiute Creek, Deep Creek, Thomas Creek, Little Thomas Creek, Smith Creek, Little Smith Creek, Pole Creek, Camel Creek, Camas Creek, Dry Creek, Beaver Creek, Castle Creek, Nip and Tuck Creek, Hurry back Creek, Stoneman Creek, Current Creek, Dons Creek, Corral Creek, East and West Fork Red Canyon Creek, Pete's Creek, Nickel Creek -- all listed for sediment, temperature, flow alteration, aesthetics, bacteria.	Some of the mentioned water bodies have been recommended as water quality limited and will be considered for placement on the next §303(d) list. If data exists which indicates these streams are impaired by these pollutants, DEQ encourages public input with appropriate data to support this position during the §303(d) listing process.
Algae, Dissolved Oxygen. Your TMDL fails to examine the impacts of algae growth in late summer on water quality in nearly all streams. This is a big oversight. Data must be collected during periods of maximum algal blooms so that you understand pollutants/impairment at levels that "make or break" survival of native salmonids and other aquatic organisms.	The presence of considerable algae growth in Deep Creek in mid to late summer initiated a need for dissolved oxygen monitoring. Based on the data collected, dissolved oxygen will be recommended as a pollutant for the next §303(d) listing cycle for Deep Creek. If data exists which indicates streams are impaired by excessive algae, DEQ encourages public input with appropriate data to support this position during the §303(d) listing process.

In order to fully consider and assess the appropriate controls and develop appropriate pollution control actions in the Upper Owyhee watershed to limit pollutant loads, you must first adequately and honestly address the causes of pollution.	Rangeland was identified as the dominant land use and allocations were established for this use. Source identification was based on the rangeland land use. Rangeland as defined in Webster's Ninth New Collegiate Dictionary as: land used or suitable for range. Range as defined in the same publication as: an open region over which animals (as livestock) may roam and feed.
We also request that you analyze water samples from small streams, reservoirs and springs and seeps for hormones and other chemicals stemming from growth implants in cattle. This is necessary, as these chemicals in even minute concentrations, can effect aquatic organisms.	If data exists which indicates streams are impaired by hormones and other chemicals stemming from growth implants in cattle, DEQ encourages public input with appropriate data to support this position during the §303(d) listing process.
We have e-mailed you on your Website, when requesting this TMDL. In that request, we asked that you hold a meeting on this TMDL in Boise. You are holding two meetings in the livestock industry towns in Owyhee County, yet have failed to schedule a meeting where the recreational public and other non-extractive users of these lands live. We reiterate that request here.	E-Mail was sent to commenter on November 14, 2002 and stated: Thank you for your comments on the Upper Owyhee SBA and TMDL. We have chosen not to have another meeting. However, we could meet with you in our offices and go over the information provided in the other two meetings. Please let us know if you are interested in this arrangement.
Specific comments:	
p. 11. Paiute Creek is a horribly degraded watershed that during brief spring runoff periods delivers sediments and livestock waste to the main Owyhee River. We have seen no evidence in this report that supports its non-listing.	If data exists which indicates Paiute Creek is impaired by sediment and bacteria, DEQ encourages public input with appropriate data to support this position during the §303(d) listing process.
p. 17. You state that Blue Creek Reservoir was constructed in 1935 and is privately owned, but is entirely on lands managed by BLM. Please explain this.	Water release is managed by the private landowner that may have water rights from the reservoir. The Idaho Department of Water Resources (IDWR) 1971 identified the dam as constructed in 1935 by private resources.
p. 17. Why was Nickel Creek not evaluated below Mud Flat road? There is a large drainage area here, and it is very damaged by livestock. How can you do a TMDL/assessment for the Deep Creek watershed and not assess the greatest length of an important and degraded tributary?	Deep Creek was assessed from the headwaters to the mouth. If data exists which indicates Nickel Creek below Mud Flat Road is impaired, DEQ encourages public input with appropriate data to support this position during the §303(d) listing process.
p. 17 makes passing reference to the existence of springs and seeps -- yet no analysis of any kind has been undertaken here. They are important, often headwater sites. Although flow may be discontinuous in some areas, many have continuous flow in runoff periods.	Page 17 is in reference to the hydrology of the Upper Owyhee Watershed. DEQ does not currently have a protocol for monitoring springs, seeps and intermittent streams. As such, resources were not allocated to evaluate springs and seeps as pollution sources.

p. 18. What are the land use practices causing incised stream channels? Your explanation here is laughably limited -- that the loss of beavers is responsible for the problems afflicting these watersheds. In many of the watersheds, any beaver that tried to live here in 2002 would starve to death, as wanton livestock abuse has stripped vegetation necessary to keep beavers from starving to death.	Our interpretation of the information provided on page 18 is that stream downcutting <u>began</u> with the removal of beavers from the watershed. Current land use practices have complicated the situation by removing riparian vegetation.
You cite Dupont 1999a and Thomas et al 1998 as support for the sweeping contention that lack of beavers is the fundamental problem here. Review of the bibliography shows that Dupont (perhaps associated with IDL -- an agency widely known for disastrous management of livestock and covering up for the livestock industry) wrote a Memo that you use as a basis for your glaringingly unscientific and unprofessional discussion of causes of pollution and impairment here.	The discussion of beavers in this section is to address the hydraulic modifications that have probably occurred in the watershed over the last 200 years. Section 3.2 does describe in greater detail the overall impacts that the loss of the beavers <u>and</u> the loss of vegetation can have on the hydrology of a water body.
The Thomas source is a general “circular” on ground and surface water, and can not be used a basis for claiming that lack of beaver is the cause of current impairment of these livestock-trashed Owyhee drainages.	Thomas et al. (1998) is a reference to discuss the interaction between surface and ground water. The reference is to demonstrate that ground water-surface water interface is an important component for stream water temperature.
p. 29 claims that western juniper has invaded large areas of the SBA. Please provide comprehensive data to support this assertion. If an invasion has occurred -- what has been the cause?	The word “large” is not used in the discussion of juniper invasion. The source for the reference of the invasion of juniper species is the BLM’s Owyhee Resource Management Plan (1999). The current invasion is cited on page 29 and referenced to Bedell et al. (1991).
You fail to discuss the growing problems with weeds in the assessment area. We refer you to BLM’s current Nickel Creek allotment assessment, where the invasion of burned areas in TMDL area lands by shallow-rooted cheatgrass and other weeds, and their deteriorated post-burn condition, is discussed.	The presence of cheatgrass will be acknowledged in section 1.2 of the SBA.
Here, as innumerable other Owyhee places referenced in the assessment, what are the “past and current land uses” that have altered vegetation composition in many areas? Martian spaceships landing? Cows??? Choose one. Please explain how grazing as a land use causes the damage documented in the assessment/TMDL.	The reference is to the loss of near surface ground water, which reduces the presence of hydrophilic species that require the near surface ground water. The hydraulic modifications referenced the down cutting on the wet meadow type channels. Further discussion of hydraulic modifications is found in section 3.2.
Your assessment completely lacks any assessment of hydrology/hydrological processes in old growth western juniper communities. As you refer to an invasion of hydrophobic species to the water’s edge in upper portions of Red Canyon, Deep and Pole Creeks û you must also recognize that there are	It is agreed that more studies must be completed on the question of Western juniper in the Upper Owyhee Watershed. In many scientific journals the extent of juniper expansion is debated in many areas on southwest Idaho and eastern Oregon. However, it is generally agreed that Western juniper primary

important old growth juniper woodlands here, with hydrology that needs to be fully understood. Plus, if junipers are now growing in former wetland sites -- there is a cause - and that cause is ongoing livestock degradation (grazing and mechanical trampling damage) to these wetlands. Raising the water tables by controlling/eliminating grazing is the essential first step in repairing these sites. Until that is done, it is only the root systems of junipers that in many places provide any structural stability/resistance to massive erosion in these damaged watersheds.	habitat is associated with rocky crag areas where wild-land fire plays a less important role than in the shrub-lands of the sage brush/steppe areas. It is also recognized the frequency of ground fires in these areas were, at one time, a critical component for maintaining climax species associated with the sagebrush/steppe vegetation communities.
p. 30 specie???	This will be changed to “species.”
p. 30. Please provide this and all other BLM fish data in appendices to the final document.	DEQ will provide a copy of this data upon request.
p. 32. Please refer to the 2001 spotted frog report to document current rancher destruction of beaver dams in these TMDL watersheds.	Amphibians are recognized in the Water Body Assessment Guidance as aquatic species that will be factored into the assessment of fish populations. If data becomes available that indicates impairment of intermittent streams, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.
p. 33 Please provide the names of the large corporations and grazing associations you refer to here, and provide maps showing the land areas impacted by their activities, and the current condition of the watersheds in these areas. We note that Owyhee ranchers form grazing associations to circumvent paying a surcharge fee for running someone else’s cattle on BLM lands. We also note that general lawlessness, trespass and failure to abide by any standards of use is the norm on BLM lands throughout the assessment area. You should also review agency trespass files in order to understand the difficulty of regulating grazing under the current scenario.	Your comments are noted.
p. 41. Please consider our preceding comments to be a “formal complaint” about livestock impairment of aesthetics in all waters in the TMDL. All assessment-area streams should be listed for aesthetics. You have now received a formal complaint! Please let us know if we need to provide more information.	Aesthetic values are protected under the General Surface Water Criteria (58.01.02.200.01.09). DEQ encourages public input such as this during the §303(d) listing process.
p. 43. Why were many of the existing uses in this table “not evaluated”? Does DEQ blindly close its eyes to water quality problems other than those specifically identified on the 1998 303(d) list? DEQ makes a very big deal about the remoteness and long distances to some of these sites. Given this situation, it would be in the interest of taxpayers if	An explanation of the existing use determination is located on page 42. DEQ applies the most stringent criteria to determine support status. If a water body has an existing use (i.e. cold water aquatic life) then the WQS criteria to determine compliance with that use is applied. Cold water aquatic life criteria is the most stringent (for aquatic life uses) with regards to

DEQ maximized its time afield, and conducted a complete and thorough "look" at all water quality impact while it was out there.	temperature, dissolved oxygen, pH, dissolved gases and other criteria Bacteria sampling was conducted on those water bodies with bacteria listed as a pollutant of concern (IDEQ 2001). Other water bodies not listed for bacteria did not receive bacteria monitoring due to restraints in holding time (24 hours) and was not built into as a component for monitoring (IDEQ 2001).
Could you explain how the presence or absence of salmonids in a stream effects DEQ's evaluation/analysis/assessment? We are confused. If a stream is listed and is supposed to have salmonids, or recently had salmonids but now they are gone, does this effect the analyses undertaken?	The first component of the SBA is to determine the existing uses of a water body (page 42). For many of the water bodies in the Upper Owyhee Watershed the Idaho Department of Fish and Game (IDFG) has management objectives to manage these water bodies (Deep Creek and Battle Creek) for wild-stock redband trout, which includes the self propagation of that species. The second step is to determine if that use is supported. This step examines historic fish and other biological data, along with compliance with narrative and numeric criteria set in the WQS. The final step of the SBA is to determine if the pollutant(s) of concern are impairing the existing uses.
p. 44. Both Blue Creek Reservoir and Juniper Basin Reservoir are vile hideously polluted, discolored, algae filled waters surrounded by voluminous amounts of livestock waste. In 1998, while employed by IDFG, I was involved in a sage grouse trapping effort in the vicinity of Riddle, and initially attempted to camp by Blue Creek Reservoir in September. It was such a squalid, polluted, leech-filled mess that we did not want our dogs drinking the water, and relocated. Aesthetics and wildlife uses are definitely impaired here! I have repeatedly observed cattle standing knee-deep in the brown murk of Juniper Basin Reservoir, inevitably depositing waste directly into these waters.	Comments noted.
We ask that you contact the IDFG vet at the Caine vet lab in Caldwell. There is an IDFG analysis of extensive water quality data collected as part of a spotted frog study in the Owyhee uplands that we ask you to review here, and include this data on the extreme pollution levels found in these Owyhee Upland water samples, and incorporate it into this assessment. This data demonstrates that springs, seeps, headwater streams are being grossly polluted by livestock fecal material. It is precisely these headwater streams and other water bodies where declining species of native wildlife like sage grouse	Amphibians are recognized in the Water Body Assessment Guidance as aquatic species that will be factored into the assessment of fish populations. If data becomes available that indicates impairment of intermittent streams, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.

must drink. In many instances, they are drinking a slurry of cow manure, urine and probable excreted hormones. Sage grouse, migratory birds, antelope and other native wildlife do not wade into flowing water to get a drink -- instead, they drink from pond or spring margins û which are the most grossly polluted areas. If DEQ is to honestly assess impairment for beneficial uses by wildlife, recreationalists dogs, etc. MUST sample water in these locations.	
p. 44. Deep Creek is floated by kayakers, and must have a designated beneficial use for primary and secondary contact human recreation. This activity has been occurring for over a decade, and you must include this use for Deep Creek. The TMDL statement that “Deep Creek does not have designated beneficial uses except for water supply, aesthetics, and wildlife habitat”, and “there is no indication that these uses are impaired” demonstrate DEQ’s failure to adequately collect data on the streams covered by this assessment/TMDL.	The SBA (Table 23) recommends that primary contact recreation as a designated beneficial use for Deep Creek. If data becomes available that indicates impairment of Deep Creek for contact recreation, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.
ALL streams with fish, or where there are supposed to be fish which have recently disappeared due to pervasive livestock damage, must also have a designation for primary and secondary contact recreation as anglers come in contact with these waters.	The SBA (Table 23) recommends designated uses for water bodies in the Upper Owyhee Watershed.
p. 47 states that EPA “does not believe that flow, or lack of flow is a pollutant”. However, if you are to honestly assess wq impacts here, you must consider the causes and impacts of reduced flow in exacerbating wq impairment. For example, if stream flow is greatly reduced due to irrigation diversion or livestock destruction of a watershed, then pollutants will be more greatly concentrated in less volume of water than they would be in a healthy watershed, or water was not diverted. Algal growth, temperature increases, DO, elevated bacteria levels, are all exacerbated by low flows. These low flow times are also the most critical for aquatic species, as well as wildlife dependent on these waters for drinking.	Comments noted. Please refer to Section 502(6) of the Clean Water Act.
p. 47. Castle Creek, and all streams considered in this TMDL need to have recreation standards/designations of beneficial use. These include PCR, CWAL, water supply, aesthetics, wildlife habitat.	The SBA (Table 23) recommends designated uses for water bodies in the Upper Owyhee Watershed.
p. 49 states that Red Canyon Creek is “the only listed segment that has established designated uses”. We ask that you carefully review the extensive data in LSRD BLM files about the livestock damage to this stream in the Trout Springs allotment	A temperature TMDL was developed to address the designated uses in Red Canyon Creek. If data becomes available that indicates impairment of Red Canyon Creek, DEQ will consider this information for future assessment and TMDLs, if necessary.

(headwaters of Red Canyon Creek), and Bull Basin allotment. BLM has a utilization cage in the West Fork of Red Canyon Creek, and has been collecting stubble height and other data on livestock damage here for approximately five years. We have frequently visited this site, which most closely resembles a feedlot.It is abundantly clear that these beneficial uses are being impaired.	DEQ encourages public input such as this during the §303(d) listing process.
This site is relatively easy to get to, and your failure to collect bacteria samples in this stream segment is indefensible.	Bacteria is not a listed pollutant of concern for Red Canyon Creek and thus did not receive bacteria monitoring. If data becomes available that indicates impairment of Red Canyon Creek, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.
p. 52. While you discuss DO and "nuisance aquatic growth", you rarely quantitatively or qualitatively assess these in this document. A few photographs of green slime pools of water, or algae-encrusted rocks in September in Pole Creek, for example, and which are very common in the TMDL area, would be a good idea.	Comments noted.
p. 59. This document discusses narrative sediment criteria and numeric turbidity criteria as a method of determining violations of wqs. Where in this document are narrative sediment analyses for each stream presented? Where are all of the numeric turbidity data presented? When were these data sets collected? What criteria do you use in a narrative sediment assessment?	Section 2.3 (Sediment) discusses the biological indicators found, or not found, for each stream that has sediment listed as a pollutant of concern. Tables 17 and 18 shows the criteria used to determine whether sediment is impairing the existing uses.
p. 63. You refer to redband trout observed in 1993 in lower Red Canyon Creek, yet elsewhere you state that Red Canyon Creek dried up in a recent year. What were the wq conditions for trout left in pools during this dry period?	These pools were not evaluated and will be recognized as a data gap.
We do not understand how you determined that sediment is not a limiting factor in Red Canyon Creek. You appear to have only analyzed percent fines, and not bedload sediment during periods when livestock are present in a stream reach, or when runoff is occurring. Livestock loitering by streams in the Owyhees typically disturb banks and bottom sediments, and a large amount of water murkiness results. Thus, unless you collect data during the period when livestock are present and greatly disturbing the streambanks and waters, you can not understand impairment factors.	To determine compliance with the general water quality criteria for sediment (IDAPA §58.01.02.200.08) biological indicators were evaluated. In the case of Red Canyon Creek, macroinvertebrate and periphyton samples were used to determine the status of beneficial uses. These samples did not indicate sediment was impairing the biological communities. Historic fish data also indicated that cold water aquatic life and salmonid spawning was present with a diverse age class of salmonid species.
p. 64. Why did you look for percent fines/sediment in a reach of Red Canyon Creek with high gradient only? The lower reach, where rbt are known to be	To determine compliance with the general water quality criteria for sediment (IDAPA §58.01.02.200.08) biological indicators were

present (p. 64), is a lower gradient. You can not use your flawed data collection procedures as a basis for concluding that this stream should be de-listed for sediment.	evaluated. In the case of Red Canyon Creek, macroinvertebrate and periphyton samples were used to determine the status of beneficial uses. These samples did not indicate sediment was impairing the biological communities. Historic fish data also indicated that cold water aquatic life and salmonid spawning was present with a diverse age class of salmonid species.
p. 64. Please review data in IDFG report (Allen et. al. 1993) for lower sections of Nickel Creek. I was present on these surveys, and livestock grazing is contributing to significant algal growth stench, sediment/turbidity/discoloration of water, and impacts to riparian vegetation were observed. You must assess the entire drainage, as it makes no sense whatsoever to only examine the upper portion of this Deep Creek tributary.	If data becomes available that indicates impairment of Nickel Creek, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.
p. 65. You refer to Ingham 2001. Please provide us with a copy of this analysis or data that are the basis of Ingham's "personal communication" here.	A copy of flow data sheets and photo will be available with landowner's permission.
pages 65-69. Please provide data on livestock presence/absence when all data used as a basis for this table were collected.	This observation was not a component of the monitoring plan (Ingham 2000) and was not documented.
pages 71 to 72. You have devoted 1 and a quarter pages to bacteria analyses. Table 19 reveals that you have collected one, and possibly two, of your 3 one-point-in-time bacteria samples for Battle Creek within the largest livestock exclosure in LSRD lands. This shows the supremely flawed and livestock industry favoring approach to wq standards that pervade this assessment/TMDL.	Comments noted.
Plus, you simply failed to make the effort to get samples in Shoofly Creek during an appropriate time of year- i.e when water was present.	Comments noted.
We have no sympathy for your claims of area remoteness in and inaccessibility that you use to explain away the gaping holes in data. Advance planning, concentrated effort and coordination with other agencies like BLM (who has had crews in the field on a regular basis in much of this area conducting various allotment assessments) could readily have yielded a comprehensive set of data for this analysis.	Comments noted.

p. 76- Is this a typo- do you mean Beaver Creek at the end of paragraph 3?	This will be changed to Beaver Creek.
p. 76. We believe you need to develop TMDLs for all of the tributary drainages that you cast aside such as Beaver Creek, Camel Creek, Dry Creek, the entire length of Nickel Creek, etc. How are you going to be able to control sediment and temperature impairment in mainstem drainages if you do not address impairment in the extensive array of tributaries?	The sediment TMDL takes into account total miles in all 2^{nd} order or larger water bodies in the Deep Creek watershed, which includes Beaver Creek, Camel Creek and Nickel Creek. Dry Creek is in the Battle Creek watershed, which does not have sediment, listed as a pollutant of concern. Further biological evaluations need to occur to determine if sediment is impairing the existing uses in Dry Creek.
p. 77. We disagree with delisting of Shoofly Creek. You failed to collect necessary data on Shoofly Creek upstream of the Reservoir. Without that data, you can not delist the entire stream.	If data becomes available that indicates impairment of Shoofly Creek, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.
p. 79. How can you possibly discuss a "Pollutant Source Inventory" and not discuss livestock congregating on and around high desert riparian areas in the Upper Owyhee - trampling and collapsing unvegetated streambanks, defecating in water, stripping vegetation necessary to protect banks from erosion runoff and filter out sediment??????	Rangeland is the primary land use in the Upper Owyhee. Sources of sediment were identified from streambank erosion, overland flow and internal loading. The removal of vegetation was also identified as having an affect on streambank stability and erosion.
p. 80. You rely on Dupont's 1999 claim in a Memorandum as a basis for the crazed and erroneous contention that "the current down-cutting if the streams in the North and Middle Fork Owyhee watersheds is probably not associated with current land use practices, but with the removal of beavers from the area" and claim "this is also true for those streams in the Upper Owyhee Watershed". Such gross misunderstanding of the role of current livestock grazing in stream downcutting shows the extreme bias of IDEQ towards protecting the interest of the livestock industry at all costs. For example, photo 15, page 88 shows a "nickpoint on Castle Creek". It is not the lack of beavers that is causing the nick point. It is the extreme grazing disturbance causing down-cutting and erosion throughout the watershed. We note that this, as most of the photos in the TMDL, was taken in a period when livestock appear to not be present.	The reference to Dupont 1999 only states that the degrading of hydrologic condition probably began with the removal of beavers in the early 1800's. The statement also explains that current land use practices in some areas will also contribute to degraded streambank conditions.
You need to consider the watershed-level impacts or declines in native herbaceous vegetation, and increases in exotic weedy species (shallow-rooted, poor watershed stabilizers) in all of these watersheds. Not only must there be vegetation on	Water body morphology and vegetation were discussed in Section 1.2 and 3.2 as well as the effects these current conditions may have on the vegetation. The effects the current vegetation may have on streambank stability was also discussed.

streambanks to filter sediment and slow erosion, but the uplands must heal and recover from current widespread livestock damage. Likewise, you need to discuss the watershed-level losses in microbiotic crusts caused by livestock trampling	How proper vegetation cover will induce better surface-ground water interface was also discussed. Upland conditions were not considered because of the overall lack of data on sediment delivery rates from uplands. Available data also indicates the uplands have a large quantity of land that is classified as low erosion potential.
p. 91 fails to mention the most effective potential management "tool"/action of all in bringing about satisfactory riparian condition, i.e, removal of livestock from the watershed.	Page 91 is located in Section 4.2, which discusses current practices to address non-point pollution sources in the Upper Owyhee Watershed. Management activity to achieve the goals of the TMDL will be developed in the Implementation Plan.
TMDL 93-110. Again here, without fully taking in to account livestock as the overwhelming causal agent in wq impairment here, we do not believe you can develop an adequate, or science-based, TMDL. You say that your model is based on "rangeland". What are the inputs and assumptions in this model that deal with livestock grazing?	There are many variables used in the model, but land use is not included.
You claim to calculate pollutant loads by source. How can you do this if you do not include tributary drainages in the TMDL? For example, you have failed to do an assessment of all of Nickel Creek, and some other tribs in the Deep Creek watershed. These drainages are all a source of sediment, bacteria, flow reduction (due to livestock-caused downcutting and loss of riparian habitats) and heat-loading input for the mainstem where you claim to do a TMDL. To address wq impairment on the mainstem, you have to fix the tributaries and headwaters.	Sediment load calculation took into account 2nd order streams or larger for the entire Deep Creek watershed. A streambank stability target will be applicable for all water bodies meeting the criteria. The temperature TMDL is applicable only to those segments listed and determined to exceed WQS. As stated in Section 5.2 upstream or headwater reductions will be required to achieve WQS for the month of June.
You also claim that a required part of loading analysis is quantification of current pollutants by source. Again, this is impossible to do unless you grapple with details of livestock abuse, in all trib. drainages/watersheds.	Source identification was based on the rangeland land use. <u>Rangeland</u> as defined in Webster's Ninth New Collegiate Dictionary as: land used or suitable for range. <u>Range</u> as defined in the same publication as: an open region over which animals (as livestock) may roam and feed.
You state that "a required part of the loading analysis is that the load capacity be based on critical conditions" -- the conditions when wqs are most likely to be violated. Again here, you need to grapple with the details of livestock grazing, and YOU NEED TO HAVE CONDUCTED YOUR ASSESSMENT AT TIMES AND IN AREAS WHERE LIVESTOCK ARE PRESENT. You have failed to do this -- as with collecting water samples for bacteria assessment inside an exclosure, or examining stream sediment or turbidity during periods when livestock may not be present. Anyone	The critical period is designed to address a critical period for the support of the existing or designated beneficial uses. Temperature during salmonid spawning and incubation periods was found to be the most critical period. This translated into the temperature criteria for the month of June. Sediment must be addressed on an annual basis. Surrogate measures such as improved bank stability and decreased percent fines will apply as yearly management targets.

who has spent a day on public lands in Owyhee County realizes the impacts of livestock moving in and around streams on increased water turbidity and soil/sediment (suspended and bedload) disturbance.	
We note that you rely on a discharge model by Hortness and Berenbrock - was this model developed for forested lands? How does it factor in grazing disturbance?	The model by Hortness and Berenbrock was developed to estimate discharge for eight regions within the state of Idaho. A forestry component is built into the model. The documentation for the model can be found at : http://idaho.usgs.gov/PDF/wri014093/ There is no component for rangeland land use. However, the shade components are similar and can be applied to appropriate elevations.
We believe there are 2 peaks in turbidity and sediment loading -- during spring runoff - you have collected no data then, and during the period when livestock are actively grazing a watershed/stream segment. You have not provided data that shows you have examined this, either.	Turbidity samples were collected in late summer on Juniper Basin Reservoir and Blue Creek Reservoir. A linkage to detrimental effects on aquatic life was used to establish a reasonable target. If data becomes available that indicates impairment of streams in the Upper Owyhee watershed, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.
p. 102. You discuss load capacity targets of 50-80 and mg/l for sediment û are the load capacity targets to be attained during periods of maximum disturbance (runoff, cows present), or are they to be averaged over a year?	The 50 mg/l and 80 mg/l suspended sediment target are based on a monthly average and fourteen day averages, respectively.
Please provide us with a copy of the all the various models you used in TMDL development (Hortness, Seronko, Horsburgh, etc.). It is necessary to review these in order to understand the claims made in this TMDL.	The model by Hortness and Berenbrock can be found at : http://idaho.usgs.gov/PDF/wri014093/ The Modified Universal Soil Loss Equation can be found at: http://www.sedlab.olemiss.edu/rusle/registration.html The Stream Segment Temperature Model can be found at: http://www.mesc.usgs.gov/rsm/rsm download.htm#TEMP The monitoring mentioned in Horsburgh will be provided.
p. 102. If streambank erosion is the largest contributor to surface sediment loads, you need to consider all streambanks in the watershed û not just mainstems.	The sediment TMDL take into account total miles in all 2nd order or larger water bodies in the Deep Creek watershed, which includes Beaver Creek, Camel Creek and Nickel Creek.

You claim that streambank erosion rates between 7.8 to 27.2 tons/mile/year will provide adequate targets. Doesn't this erosion rate mean that streams will still be downcutting, losing their floodplains, etc.?	Streambank erosion targets are based on the allowable sediment loading to the water bodies. With suspended sediment target of 50 mg/l an overall sediment load is calculated based on information from the Hortness and Berenbrock model for estimating monthly stream flow. Once a load was calculated, the amount of streambank erosion allowed to achieve the in-stream target was determined.
Also -- we believe you MUST consider the impacts of overland and ephemeral drainage soil erosion throughout the watersheds during runoff periods. How much sediment do they contribute? It is our direct observation from looking at "pedestaled" exclosures in the Owyhee uplands that 6ö of soil has eroded away from relatively flat surface areas in the past 30-40 years. How would an erosion rate of 6ö of soil in flat upland areas every 40 years (estimate some water, some wind loss) translate into sediment loads in Upper Owyhee streams? How does this rate compare to p. 102 Table 33, which discusses "estimated overland erosion". What do these numbers mean? Are the table numbers ONLY for the watershed segments where streams were assessed in this current process? Thus they would not include steeper east face Juniper Mountain streams? Does the Seronko model use various levels of vegetation and microbiotic crust cover under various (or NO) grazing levels/intensities? This is essential to understand the time frame and canges needed to meet TMDL goals, and to run accurate models that predict real world outcomes.	Overland erosion rate was determined via the Owyhee Resource Management Plan (1999) and the Modified Universal Soil Loss Equation. The model does not estimate delivery rates to water bodies. If information is available to calculate delivery rates it will be examined to determine applicability to the SBA-TMDL.
You say average stream width-depth ratios in the Upper Owyhee watershed are at a ratio of 25:1. You then adjust this number to 12:1 for final analysis. Is this 12:1 ratio the end-goal of your TMDL? How will such large width-depth ratios (12:1) in many of these small streams translate into acceptable habitat for aquatic species?	The end goal of stream morphology is site potential.
p. 104. Please elaborate on "natural sources" of pollution. Domestic livestock are NOT natural components of the Owyhee ecosystem/watersheds. What is the "natural" pollution source without livestock? Under both historic and current conditions?	Pollution sources in the Upper Owyhee are from natural and non-point sources. Natural sources are sources that that are not human induced. There is a certain amount of heat input into any water body that can not be controlled and is not associated with a human induced situation. All water bodies in a lotic environment will cause a natural erosion process without human intervention.
p. 105. The statement that "enhancement of streambank vegetation will promote bank stability à morphology. This will increase ground water supply and the hyporheic flow conditions ...". Please	Please refer to Thomas et al 1998, Wrobilicky et al. 1996 and Poole and Berman for discussion on hyporheic flows and surface water conditions.

elaborate on these statements, and explain how this all works in greater detail.	
p. 107. You state the entire load allocation is assigned to the primary land use, rangeland. Again here, please elaborate on what is meant by “rangeland”. Does it imply livestock grazing s an extractive use?	Source identification was based on the rangeland land use. Rangeland as defined in Webster’s Ninth New Collegiate Dictionary is: land used or suitable for range. Range as defined in the same publication as: an open region over which animals (as livestock) may roam and feed.
p. 105 raises concerns about “drought”. Drought is a natural condition û livestock grazing has exacerbated drought impacts. Earlier you said that calculations (as in load capacity) must be based on critical conditions. Drought is a natural “critical” condition, so it is entirely appropriate that you collected data during a drought period. Plus, the watershed degradation from livestock grazing during drought years leave watersheds stripped of vegetation necessary to slow down spring flows in even normal spring high water periods. A “worst case scenario” is drought followed by a high water spring runoff event.	Drought conditions were addressed and presented as a Margin of Safety to be considered in the temperature model validation.
Finally, you need to add the East Fork Owyhee River, into which these streams flow, to the 303d list. This stream has chocolate water during runoff, dense algal growths in slack water areas in summer, no longer has more than a handful of native rbt, etc.	If data becomes available that indicates impairment of streams in the Upper Owyhee watershed, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.
This TMDL should calculate time frames for recovery, removing impairment, based on no grazing, limited grazing, removal of livestock from most damaged watersheds, etc scenarios. What will recovery time frames be under various levels of relief from livestock grazing? The public is simply not willing to wait your estimated 20-100 years for achievement of wq standards in these nationally significant public wild lands.	This type of information will in all likelihood be included in an implementation plan.
We have reviewed the BLM 1:100,000 Riddle land status map. This maps clearly shows that one-third of the surface area of Ross Lake is surrounded by BLM lands. You avoid doing any assessment or TMDL on Ross Lake by claiming it is on Duck Valley Indian Reservation lands. This must be corrected, and an assessment done, as a significant part of this playalike lake is surrounded and affected by public lands. These lands and intermittent drainages are significantly degraded by livestock grazing by Petan Ranches. In addition, we failed to include the following streams in the list that need to be assessed for all possible impairments	Ross Lake is a dry-lake bed as determined on USGS 7.5 Quad Maps and was not on the Idaho 1998 §303(d) List and was not evaluated for this SBA-TMDL process. If data becomes available that indicates impairment of streams in the Upper Owyhee watershed, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.

as part of the TMDL assessment process: Dickshooter Creek, Shoofly Creek, Harris Creek, Blue Creek, Little Blue Creek, Payne Creek, Squaw Creek, Ross Slough, Red Basin Creek, Carter Creek, Long Meadow Creek, and need to be listed for all impairments on the next 303d list.	
Another major reason that you must conduct an assessment/TMDL on the East Fork Owyhee is the documented mine pollution problems/chemical leaching just upstream of Duck Valley at the Rio Tinto mine near Mountain City. These pollutants will be carried downstream into Idaho East Fork Owyhee waters.	If data becomes available that indicates impairment of streams in the Upper Owyhee watershed, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.
Again, please also consider these as early comments on the upcoming 303d listing process.	If data becomes available that indicates impairment of streams in the Upper Owyhee watershed, DEQ will consider this information for future assessment and TMDLs, if necessary. DEQ encourages public input such as this during the §303(d) listing process.

Comments Received From: Robbin Finch, City of Boise Date Received: November 22, 2002	Response:
The draft TMDL is generally well written and documented. DEQ staff have done a very good job of collecting information and characterizing conditions in a geographically challenging area. 2. Temperature Targets The draft TMDL proposes use of the cold water aquatic life and salmonid spawning water quality criteria for temperature (19C average/22C maximum and 9C average and 13C manimum, respectively) as applicable temperature criteria that are appropriate for maintenance of natural reproduction of Redband trout.	Comment noted. Comment noted.
The Columbia River redband trout Oncorhynchus mykiss gairdneri, a subspecies of rainbow trout Oncorhynchus mykiss, is native to the Fraser and Columbia River drainages east of the Cascade Mountains to barrier falls on the Pend Oreille, Spokane, Snake and Kootenai rivers (Allendorf et al. 1980; Behnke 1992). Redbands have adapted to the natural harsh water quality conditions, including high temperature, low dissolved oxygen and large variation in pH, common to interior and desert streams in Washington, Oregon, Idaho, Oregon and California.	It is agreed that the redband trout has adapted to the harsher environment associated with the arid areas of the Pacific Northwest, and many studies have demonstrated this survival record. Several streams in the Owyhee watershed are included in the Idaho Department of Fish and Game’s Fisheries Management Plan as managed for wild stocks of redband trout (cold water aquatic life).
The temperature targets for the TMDL are lower than necessary and for many streams in the Upper Owyhee and other portions of the state attainable, due to natural conditions. Recent Idaho Fish and Game assessments in the Owyhee (Allen et al,1995) suggest that temperatures substantially greater than those proposed in the draft TMDL are more than adequate for redband survival.	Whether or not the cold water aquatic life temperature standard is attainable or not was not within the scope of this SBA-TMDL. This type of decision can only be made upon completion of a Use Attainability Analysis (UAA).
“Basic water quality parameters of water temperature, pH, conductivity, hardness and alkalinity were all within acceptable ranges for [redband] trout survival. Recording thermographs were placed in Jordan Creek from June until November, 1995. Maximum water temperature recorded was 24.6¦C on July 16, 1995.)	Other physical attributes were not evaluated since they were not listed as pollutants of concern. It is assumed these parameters are within Idaho WQS. Jordan Creek is located in HUC 17050108.
The final TMDL should: 1. Include additional information concerning the natural history, adaptation to the desert environment, and biological needs of redband trout;	The Upper Owyhee Watershed SBA-TMDL was developed with information provided by and collected by Idaho DEQ, other federal and state agencies, and any other information provided. The information requested in the comment was not provided by the fishery management agency or by

	the federal agency who oversees most of the land management in the Upper Owyhee Watershed. It was also not within the scope of the SBA-TMDL to include detailed information about the redband trout.
2. Select corresponding temperature and other (e.g. dissolved oxygen) water quality targets that are consistent with the natural conditions and needs of the redband species (e.g. seasonal cold water aquatic life temperature criteria or the natural background temperature narrative contained in state water quality standards).	Several streams in the watershed are included in the Idaho Department of Fish and Game's Fisheries Management Plan as managed for wild stocks of redband trout (cold water aquatic life). With this information in mind, as well as temperature data which showed violations of the WQS for temperature, such streams must be proposed for placement on the Idaho §303(d) list. If data exists which indicates that any of the streams we have proposed for the §303(d) list are in compliance with cold water aquatic life temperature standards, DEQ encourages public input with data to support this position during the §303(d) listing process. Whether or not the cold water aquatic life temperature standard is appropriate for these streams or not was not within the scope of this SBA-TMDL. Seasonal Cold Aquatic Life Use may be suitable for these streams, but this type of decision can only be made upon completion of a Use Attainability Analysis (UAA).

Comments Received From: Riddle Ranches Received via Fax: November 22, 2002	Response:
1) Is the SBA-TMDL a draft or final document? Your letter of October 21, 2002 indicates that the SBA-TMDL is a draft document. Such letter provided an Idaho Department of Environmental Quality (DEQ) web-address where the SBA-TMDL can be viewed. However, the October 2, 2002 SBA-TMDL document for the Upper Owyhee Watershed at the DEQ web-address states on its face that it is a Final Draft. The web-address document was reviewed for these comments, but ie was unclear if we were invited to comment to the SBTMDL in its entirety, or just invited to comment with regard to its proposed actions. Because the proposed actions stem directly from the SBA-TMDL findings and conclusions, we comment upon it in its entirety, including its findings, conclusions and proposed actions.	The document is a final draft. This implies that comments on the document will be reviewed with applicable comments addressed, changes made in the document, or further explanation made to clarify.
2) Does turbidity in Blue Creek Reservoir exceed Idaho's WQS? The SBA-TMDL claims that turbidity in Blue Creek Reservoir exceeded Idaho's WQS on page xviii of its Executive Summary and on ages 60 and 95 of it narrative. However, the SBA-TMDL does not report any actual measured turbidity values for Blue Creek Reservoir, or even summarize such measurements. It should provide at least a numeric summary of the turbidity data that was collected.	Tables have been added to the document in Section 2.4 to discuss in-reservoir turbidity data. The discussion on the exceedance of the turbidity criteria has been modified to address the narrative sediment criteria.
3) The Cold Water Aquatic WQS for turbidity is premised upon not exceeding background levels by either 50 NTUs instantaneously or 25 NTUs over a period of ten consecutive days (see SBA-TMDL pages 59 and 94, and October 2002 Idaho Administrative Code for DEQ at IDAPA 58.01.02.250.02.e). Thus, the Idaho Cold Water Aquatic WQS for turbidity must be evaluated in terms of how much it exceeds background levels. However, the SBA-TMDL does not determine, nor even discuss, background turbidity levels for Blue Creek Reservoir. No conclusion can be drawn regarding whether or not Blue Creek Reservoir exceeded Idaho WQS for turbidity until background turbidity levels are determined. See item 3) below for a discussion of background turbidity levels that are relevant to Blue Creek Reservoir.	The turbidity levels set in the TMDL are targets based on a linkage to detrimental effects on aquatic life. This reference to the water quality standards for turbidity will be omitted in the final submittal document. These standards relate to point source wastewater discharges. With this in mind, background concentrations are not applicable. The Idaho WQS for sediment prohibit sediment in quantities that impair the beneficial uses for the water body. An independent analysis of periphyton (Bahls 2001) showed severe impairment to the biological community in both Juniper Basin and Blue Creek Reservoirs.

4) Is the background turbidity for Blue Creek Reservoir 0 NTUs? The SBA-TMDL concludes that total turbidity load capacities for reservoirs are 25 NTUs over 10 consecutive days or 50 NTUs instantaneously on page 100. The SBA-TMDL lists the same Load Capacities for Blue Creek Reservoir in Table 31 on page 101, and the SBA-TMDL uses these total Load Capacities to calculate turbidity Load Allocations for Blue Creek Reservoir of 22.5 NTUs or 45 NTUs respectively on page 108-109.	The turbidity levels set in the TMDL are targets based on a linkage to detrimental effects on aquatic life. This reference to the water quality standards for turbidity will be omitted in the final submittal document. These standards relate to point source wastewater discharges. With this in mind, background concentrations are not applicable.
Capacities and Load Allocations are based upon the assumption that the background turbidity for Blue Creek Reservoir is 0 NTUs. However, the SBA-TMDL acknowledges on pages 105-106 that it was developed despite a lack of data and knowledge regarding existing sediment loads.	Table 39 shows the load capacity, or targets, for both Juniper Basin Reservoir and Blue Creek Reservoir. The reference to background levels located in Table 27 will be omitted in the final submitted SBA-TMDL.
Turbidity monitoring by Western Range Service (WRS) for Riddle demonstrates that the assumption of a 0 NTU background turbidity for Blue Creek Reservoir is invalid. WRS monitored turbidity levels along Blue Creek just above Blue Creek Reservoir from 1999 through 2002. A summary of such turbidity monitoring findings is presented in Table A below. (Table A is attached at the end of Riddle Ranches' Comments)	Data Table is located as last page of the Riddle Ranches comments. The data presented does not provide information on in-reservoir turbidity levels.
Several important points regarding turbidity levels for Blue Creek Reservoir can be illustrated by analyzing the date in Table A.	
First, the background turbidity level in the late spring, prior to annual livestock use, varies somewhat from year to year, apparently in response to precipitation and associated stream flow on Blue Creek. Riddle observed that precipitation at the ranch was nearly normal in 1999 and 2000. The late spring background turbidity averaged 25 NTUs prior to livestock use in those years. In contrast, precipitation at the ranch (particularly winter snow) was noticeably below average in 2001 and 2002. The turbidity of Blue Creek averaged 16 NTUs in the late spring prior to livestock in these below-normal years.	The turbidity levels set in the TMDL are targets based on a linkage to detrimental effects on aquatic life. This reference to the water quality standards for turbidity will be omitted in the final submittal document. These standards relate to point source wastewater discharges. With this in mind, background concentrations are not applicable.
Second, it is reasonable to conclude that the measured late spring turbidity levels Represent the identified maximum background turbidity levels since the measurements were made before annual livestock grazing (the primary	See response above.

rangeland use) commenced.	
The SBA-TMDL bases its load allocations on land use, which it concludes consists entirely of rangeland in the Upper Owyhee Watershed (see SBA-TMDL pages 104 and 107). Thus, the late spring turbidity measurements made in near-normal years (1999 and 2000) are the best available determinants to establish the typical late spring background turbidity level for Blue Creek Reservoir, which averaged 25 NTUs.	See responses to pervious comment.
Second, it is reasonable to conclude that the measured late spring turbidity levels represent the identified maximum background turbidity levels since the measurements were made before annual livestock grazing (the primary rangeland use) commenced. The SBA-TMDL bases its load allocations on land use, which it concludes consists entirely of rangeland in the Upper Owyhee Watershed (see SBA-TMDL pages 104 and 107). Thus, the late spring turbidity measurements made in near-normal years (a999 and 2000) are the best available determinants to establish the typical late spring background turbidity level for Blue Creek Reservoir, which averaged 25 NTUs.	The turbidity levels set in the TMDL are targets based on a linkage to detrimental effects on aquatic life. This reference to the water quality standards for turbidity will be omitted in the final submittal document. These standards relate to point source wastewater discharges. With this in mind, background concentrations are not applicable.
Third, the background turbidity level of Blue Creek decreases through the summer, apparently as a result of diminishing stream flow. The fall turbidity measurements summarized in Table A were taken near the end if the annual livestock use period when the majority of the livestock have returned to private ranch lands. Therefore, these fall measurements represent the identified minimum background turbidity levels that existed after the summer grazing periods. The fall background turbidity level averaged 7 NTUs, significantly lower than the late spring background turbidity level. Assuming a relatively constant decrease in the stream flow and associated background turbidity level during the mid-point of the livestock use period averages 16NTUs.	The turbidity levels set in the TMDL are targets based on a linkage to detrimental effects on aquatic life. This reference to the water quality standards for turbidity will be omitted in the final submittal document. These standards relate to point source wastewater discharges. With this in mind, background concentrations are not applicable.
Fourth, the turbidity level of water that is being discharged from Blue Creek Reservoir was found to be significantly greater than the turbidity level of the water flowing into the reservoir. In early May 2000, the turbidity of water being discharged at the overflow outlet of Blue Creek Reservoir was measured at 46 NTUs, while the turbidity of Blue Creek immediately above the reservoir was measured at 16 NTUs the same day. The discussion of the "sediment problem" for reservoirs in the SBA-TMDL seems to assume that any sediments	The turbidity levels set in the TMDL are targets based on a linkage to detrimental effects on aquatic life. This reference to the water quality standards for turbidity will be omitted in the final submittal document. These standards relate to point source wastewater discharges. With this in mind, background concentrations are not applicable.

that are in suspension and are measured as turbidity in the water flowing into a reservoir will settle out and contribute to the sediment load of the reservoir. The May 2000 observations revealed that the sediment load leaving the reservoir as turbidity was greater than the sediment load entering it.	
The total Load Capacity for turbidity proposed under the SBA-TMDL needs to be increased to account for background turbidity. For Blue Creek, background turbidity is about 25 NTUs in the late spring, 16 NTUs in mid summer, and 7 NTUs in the fall. Therefore, appropriate instantaneous Load Capacities are 75 NTUs in late spring, 66 NTUs in mid summer, and 57 NTUs in fall. Appropriate ten-consecutive-day Load Capacities are 50 NTUs in late spring, 41 NTUs in mid summer and 32 NTUs in fall. Subsequent Load Allocations for turbidity need to recalculated based upon the above Load Capacities.	The turbidity levels set in the TMDL are targets based on a linkage to detrimental effects on aquatic life. This reference to the water quality standards for turbidity will be omitted in the final submittal document. These standards relate to point source wastewater discharges. With this in mind, background concentrations are not applicable.
Furthermore, the Margin of Safety (MOS) used for sediment in the SBA-TMDL is primarily based upon two unknowns; existing loads and current streambank erosion rates (see SBA-TMDL page 105). The determination of background turbidity levels in the above analysis provides answers to the first unknown. Therefore, the MOS for the Load Allocations should be reduced by at least half when they are recalculated.	The turbidity levels set in the TMDL are targets based on a linkage to detrimental effects on aquatic life. This reference to the water quality standards for turbidity will be omitted in the final submittal document. These standards relate to point source wastewater discharges. With this in mind, background concentrations are not applicable.
Finally, the estimated bank erosion rates for Blue Creek shown in Table 34 (page 103 of the SBA-TMDL) are form 46 to 688 times greater than the target bank erosion rate shown in Table 32 (page 101). It is inconceivable to us that current or historic land uses could account for this magnitude of difference, particularly in light of the fact that ecological status of the associated watershed was found to be late-seral or better in both 1980 and 1997, meeting and going beyond BLM's Land Use Plan requirements for range condition and trend. The target erosion rates, or the estimated erosion rates, or both, are unrealistic and should be reevaluated.	The values represented in Table 34 are gross estimates based on a streambank study conducted in an adjacent watershed with similar characteristics. The TMDL clearly states as more information is collected by land management agencies these values will be adjusted to reflect any further findings.
5) Should Battle Creek and Shoofly Creek be removed from Idaho's "303(d)" list for bacteria? Riddle agrees with the SBA-TMDL findings that Battle Creek and Shoofly Creek fully support primary and secondary contact recreation as existing uses. Riddle also agrees with the SBA-TMDL proposed action to remove Battle Creek and Shoofly creek from Idaho's "303(d)" list.	Comments noted.

6) Should Battle Creek be added to the Idaho's "303(d)" list for temperature? The SBA-TMDL finds that Battle Creek should be added to Idaho's :3030(d)" list for temperature during the next listing cycle on pages xxiv and 48. Riddle does not agree that Battle Creek should be added to Idaho's "303(d)" list for temperature during the next listing cycle.	Comments noted and addressed below.
The SBA-TMDL estimates in Table 29 that the amount of shade required to achieve target Load Capacities for temperature is often near 100%. In fact, the June estimates for shade requirements are all 87% higher. Such high shade requirements are certainly not attainable along Battle Creek. The BLM evaluated many of the creeks within the Upper Owyhee Watershed for Wild and Scenic River eligibility. Such evaluations determined that the nature of canyon-bottom streams such as Battle Creek that are confined in deep, narrow canyons have limited potential to establish any additional streamside vegetation because of the intense streambank scouring that occurs each year during the high spring flows. Therefore, the degree of shading that the SBA-TMDL estimates is needed in order for Upper Owyhee creeks to achieve the temperature WQS for Cold Water Aquatics is not attainable along Battle Creek, and it should not be added to the "303(d)" list for temperature during the next listing cycle.	Battle Creek is included in the Idaho Department of Fish and Game's Fisheries Management Plan as managed for wild stocks of redband trout (cold water aquatic life). With this information in mind, as well as temperature data which showed violations of the WQS for temperature, Battle Creek must be proposed for placement on the Idaho §303(d) list. If data exists which indicates that Battle Creek is in compliance with cold water aquatic life temperature standards, DEQ encourages public input with data to support this position during the §303(d) listing process. Whether or not the cold water aquatic life temperature standard is attainable or not was not within the scope of this SBA-TMDL. This type of decision can only be made upon completion of a Use Attainability Analysis (UAA).
General Comments	
Information presented in the SBA-TMDL indicates that many of the streams were found to be dry during at least some of the field monitoring conducted by the Idaho DEQ. Including portions of Shoofly Creek and Blue Creek above their reservoirs. Some of the other creeks discussed were found to be dry for a period of time every year that monitoring was conducted. It does not make any sense to require that these streams achieve temperature and turbidity WQS's for Cold Water Aquatic species when the fact that they are often dry is the most significant limiting factor for such species. Therefore, Cold Water Aquatics should not be considered a valid existing use for these creeks.	**Intermittent Waters**. A stream, reach, or water body which has a period of zero (0) flow for at least one (1) week during most years. Where flow records are available, a stream with a 7Q2 hydrologically-based flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with natural perennial pools containing significant aquatic life uses are not intermittent(IDAPD §58.01.02.003.53). Since there are no historic flow data in the Upper Owyhee Watershed, streams were classified as intermittent based on USGS Topographic maps. Numeric water quality standards only apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated (IDAPD §58.01.02.070.06).
Table 29 of the SBA-TMDL estimates that the amount of shade required to achieve target Load	The target of 100% shade represents total shade targets. It is clearly stated in the TMDL that in

Capacities is often near 100%. In fact, the June estimates are all 87% or higher. Such high shade requirements are virtually unattainable anywhere within the Upper Owyhee and are certainly not attainable everywhere along the stream segments listed in the SBA-TMDL. Since the shade requirements to achieve current target temperatures are unattainable, the targets need to be changed so that they can be attained.	many of the water bodies 35% of the shade requirement will be associated with topographic shading. The vegetation shading component will then be required to produce the remainder 54-65% for the water bodies on Idaho's 1998 §303(d) list As with sediment load analysis, the shade component will have site potential characteristics built into the Implementation Plan. This will be re-written into section 5.4 to address the site potential aspect.
Riddle reserves the right to provide additional comments and input during the anticipated development of implementation and monitoring plans that will affect them (see SBA-TMDL pages xxviii and xxix). We wish to forecast for you that Blue Creek Reservoir is an irrigation reservoir.	Comments noted.

Table A. Blue Creek Turbidity Data
Collected by Western Range Service for Riddle Ranches, Inc.
1999 through 2002

Date Collected**	General Period***	Turbidity (NTU) At each study Location W-10	W-11	W-12	Average Turbidity (NTU)
6/20/1999	Late Spring	24	28	25	26
11/4/1999	Fall	10	9	12	10
6/24/2000	Late Spring	25	24	23	24
11/20/2000	Fall	4	5	4	4
6/11/2001	Late Spring	16	27	19	21
11/13/2001	Fall	9	No data	No data	9
6/10/2002	Late Spring	15	14	20	16
11/11/2002	Fall	10	2	4	5
5/28/2000	Blue Creek about ½ mile above the reservoir =				16
	Blue Creek Reservoir at overflow outlet =				46

* All data collected along Blue Creek approximately 0.5 to 1.8 mile upstream from Blue Creek Reservoir

** The 1999, 2000, and 2002 data were collected by WRS using a Horiba U-10 . Water Quality Checker. The 2001 data are based upon water samples that were collected by WRS and sent Alchem Laboratories of Boise for analysis.

*** The Late Spring period is prior to annual livestock use along Blue Creek. The Fall period is near the end of the annual livestock use along Blue Creek, when the majority of the livestock have returned to private ranch lands.

Comments From: United States Environmental Protection Agency, Region X Received via E-mail: November 22, 2002	Response:
The U.S. Environmental Protection Agency (EPA) has reviewed the draft Total Maximum Daily Load (TMDL) for the Upper Owyhee Subbasin. Overall, the TMDL is one of the best Idaho TMDLs that EPA has ever seen. EPA appreciated the explanations and pictures, the background information on the each of the water quality segments, and the reasoning behind linking water quality standards to allocations. IDEQ provided a very useful table in the Executive Summary, which listed the pollutant, whether a TMDL has been developed, recommended changes to the 303(d) list and a justification.	Comments noted.
In general we believe that it can be the basis for a final document provided that some concerns are adequately addressed. EPA's specific comments are listed below.	Comments noted.
Comment The Clean Water Act and implementing regulations require that a TMDL be established ***with consideration*** of seasonal variations. IDEQ did not explicitly include a section in the TMDL on seasonal variations for temperature or sediment although critical conditions are touched upon in the margin of safety and design condition sections. ***Recommendation*** Explain how seasonal variations were considered in the TMDL analysis, even if IDEQ decided against seasonal allocations. Seasonal variations and critical conditions can be explained together. In the section, please clarify why June to August is an appropriate seasonal allocation for temperature (e.g., only time that temperature is violated), and why the temperature varies so greatly. For the sediment TMDL, it would be helpful to include a brief explanation on seasonal variations in sediment delivery from rain-on-snow events and general precipitation runoff.	A more in-depth discussion of seasonable variation will be incorporated into Section 5.1.
Comment No explanation or reference is provided in the TMDL for the instream target of percent fines (< 6mm of 30% or less for the substrate of the Creeks). ***Recommendation*** Provide a reference or explanation on how the target of instream target of percent fines was selected.	The reference to the 30% or less for percent fines is in reference to the macroinvertebrate analysis (Relyea et al. 2000). Most species that were determined to be tolerant of sediment were found in water bodies of percent fines greater than 30%. Those determined to be more intolerant of sediment where found in substrate with percent fines less than

	30%. This will be addressed and clarified in greater detail in section 2.4 and again during discussion of sediment targets in Section 5.4.
Comments Not enough explanation on how the loading capacity for sediment targets was determined. ***Recommendation*** Provide additional detail on how loading capacity for sediment targets (listed on Tables 30-32) was determined.	Sediment load targets are based on water column TSS levels found in other TMDLs developed in the state of Idaho. Section 2.4 will address sediment impairment to beneficial uses in more detail along with a more comprehensive explanation in Section 5.4.
Comment Not enough information is provided in order to fully understand the modeling used to determine sediment loading for this TMDL. ***Recommendation*** Briefly explain how the Hortness and Berenbrock model is used to determine sediment loading and consider including additional information on the Hortness and Berenbroock (2001) discharge model in the appendix. Inputs and outputs from the discharge model would also be helpful, particularly for the flowrates calculated in determining sediment loading capacity.	DEQ recognizes that Appendix D did not contain all the information that was alluded to in the document posted on DEQ's Web Page. The final SBA-TMDL will have an in-depth discussion of the model along with spreadsheets showing input values for calculating year round flows. Appendix D will also be expanded to show input values for monthly sediment loading. Flow data calculated from the Hortness and Berenbrock model will be displayed on monthly bases, with monthly load calculations for those water bodies requiring a TMDL.
Comment The WQ criterion for turbidity includes "shall not exceed background turbidity" and it is not clear whether and how background turbidity has been determined or whether it is assumed to be 0. ***Recommendation*** Clarify how background turbidity is calculated in the turbidity target.	Juniper Basin and Blue Creek Reservoirs are remote bodies of water originally constructed to store irrigation water. Very little data exists which would allow an assessment of historic or current conditions. DEQ believes it is not possible to establish background concentrations in these watersheds, because there are no reference conditions with which to compare. DEQ believes that 25 NTU turbidity is a reasonable target in these cases that is based on a linkage to detrimental effects on aquatic life and approximates the suspended sediment target used in portions of the watershed.
Comment Why give temperature load allocations based on the month, since what happened in June 1997 could be completely different than June 2003? ***Recommendation*** Explain why temperature load allocations are based on months rather than using flow-based allocations. Since flow changes constantly, a flow-based temperature may be a more appropriate compliance point than comparing future June temperatures to the June temperature loading capacity in the TMDL.	It is agreed that water temperature and flow can vary from year to year. However, to set the surrogate target (shade) for varied flow will provide a moving target for management goals. Using the lowest flow calculated through the Hortness and Berenbrock (2001) model provides the critical end point for the lowest flows possible. Since the surrogate target is shade, establishing a target for critical low flows would also be protective during higher flows.

Comment p 103: The transition from sediment loading capacity (LC) determination back to details of temperature LC determination is confusing. ***Recommendation*** The TMDL document would be improved if IDEQ described the temperature loading capacity and then the sediment loading capacity.	Section 5 will be redesigned to provide for a more readable document.
Comment p 107: In Table 36 different temperature load allocations are given for each month. Since the load allocation is to be met by establishment of riparian vegetation, this should be the same through each of the months so it seems odd to see the allocation expressed this way. ***Recommendation*** The TMDL document would be improved if IDEQ presented the surrogate target of percent shade here and stated the most stringent requirement for each waterbody as a target.	The month of June water temperature requirements are more stringent due to the need to meet salmonid spawning requirements. The months of July and August are less stringent due to different numeric criteria for cold water aquatic life.
Comment p 107: In Table 36, different temperature load allocations are given only for June, July and August. This implies that the temperature TMDL may be a seasonal TMDL. ***Recommendation*** If the temperature TMDL is a seasonal TMDL covering only the summer months, then make this clear in the TMDL document. If not, then clearly explain why IDEQ has chosen not to make this a seasonal TMDL.	Table 29 will be repeated after Table 36 to reestablish the shade targets as a part of the total allocations of the TMDL. It will be clarified that load allocations are based on the critical and seasonal periods when water temperatures exceed WQS.
Comment p 105: The margin of safety (MOS) section for the temperature TMDL lists a number of conservative assumptions. The first, third, and fourth assumptions listed under MOS relate to future benefits not quantified in the modeling and yet anticipated to occur as a result of planned implementation activities. The fifth assumption is difficult to understand. Were drought conditions used in the model, so they were conservative assumptions representing extreme conditions? The seventh assumption discusses how data was collected for low flow conditions in drought years, stating that stream temperatures are likely to be higher than normal during these conditions. While this can be true, it is sometimes the case that water temperatures are lower in the summer months of drought years, because the water in the streams is	The assumptions stated in the MOS for temperature will be more clearly addressed with more adequate explanations. The sixth MOS explanation will state that it is addressing Deep and Castle Creek only. The fifth and seventh MOS will be incorporated into an overall discussion of drought conditions and how that may affect water temperatures used to verify the model predictions.

composed of a higher percent groundwater than surface water and the groundwater is cooler. Without more information about the area it is hard to make the determination as to which is true here, but this is not necessarily a conservative condition. It should not be stated as such unless there is evidence that the influence of groundwater during drought years is minimal. ***Recommendation*** For the third assumption, provide an explanation of how implementation is expected to lead to reestablishment of the flood plain access. For the fourth assumption, explicitly state that this assumption pertains only to Deep Creek and Castle Creek, which are covered under the sediment TMDL. Clarify the fifth assumption and for the seventh assumption, either delete this assumption or provide evidence that the influence of groundwater during drought years is minimal.	
Comment p 105-106: it appears but is not stated clearly in the text that the TMDL uses an explicit Margin of Safety of 10% of the loading capacity for the sediment TMDL. ***Recommendation*** If this is true, please clearly explain that the MOS is explicit and provide a rationale for selecting 10%.	The 10% MOS for sediment will be explained in more detail in 5.4.
Comment EPA, IDEQ and Idaho Conservation League and Lands Council agreed in a settlement agreement in 2002 to include a summary of the implementation strategies as outlined in the settlement agreement. The Executive Summary briefly describes long, medium and short term general implementation goals in very general terms such as bank stabilizing vegetation, stream canopy density changes in bank condition and vegetation utilization. Otherwise the summary outlined in the settlement agreement is not included in the proposed TMDL. ***Recommendation*** Include in the TMDL a summary of the implementation strategies, which will include expected time frame for meeting water quality standards (WQS), approaches to be used to meet load allocations, identification of federal, state and local governments and individual entities that will be involved in or responsible for implementing the TMDL, and a monitoring strategy to measure implementation activities and achievement of WQS. Include a brief summary of the strategy in the Executive Summary.	Section 4 will have a section to address implementation strategy.

Concern It is not clear the rationale IDEQ used to propose delisting Battle Creek and Shoofly Creek for bacteria based on data from a single day. ***Recommendation*** Explain why the data to delist these segments for bacteria is sufficient (by referencing Idaho's water quality standards for bacteria and Idaho's waterbody assessment guidance) or provide additional data or remove the proposal to delist these segments.	Battle Creek and Shoofly Creek were placed on the 1998 §303(d) list based on one time samples for Fecal coliform bacteria collected by the BLM in 1993. In 2000, Idaho DEQ adopted *E. coli* as the indicator for determining the support status for primary and secondary contact recreation. This assessment is based on protocols established in the Water Body Assessment Guidance (DEQ, 2002). The protocols for determining support status using *E. coli* is as follows: If a sample exceeds the WQS (406 CFUs/100 ml) for a one event sample of, it is not considered a violation of WQS, but triggers a need for additional monitoring. A geometric mean of 5 samples over a thirty day period is then required. If the WQS (126 CFU/100 ml) is exceeded, then the water body would be classified as not full support of primary contact recreation. Sample results for Battle and Shoofly Creeks were well below the standard for support of contact recreation. DEQ will continue to monitor in this area and will in all likelihood obtain additional bacteria samples in the future.
Concern IDEQ states in the TMDL document on p. 4, "This document will not attempt to assess interstate or tribal water quality concerns. However, a sediment allocation for one segment will establish a sediment reduction from the state of Nevada." ***Recommendation*** Provide an explanation on the contradiction within the above statements.	IDEQ will not <u>assess</u> the water quality or beneficial use(s) status on tribal or other state's waters. A sediment allocation is given to streams flowing from Nevada. This will be clarified on page 4.
pp xiv & 5: Stream mileages are different from one table to another.	The miles or acres stated in Tables A and 5 will be addressed and modified as needed.
p xvii: Table B under Pole Creek, recommended changes to 1998(d) list should be delist sediment; under Nickel Creek add temperature, metals and organic enrichment under proposed future listing-pollutant of concern; under Deep Creek add dissolved oxygen (or nutrients) under proposed future listing-pollutant of concern (see p 75);	Table B will be modified to address these concerns.
Add Camel Creek, Beaver Creek, Dry Creek, and Camas Creek for unknown pollutants (or temperature for Camas Creek–this is not clear) under proposed future listing-pollutant of concern (p	The Table B will be modified to address these concerns.

75-6) . p 43:	
Table 7, none of the columns have been completed for Castle Creek.	The Table 7 will be modified to address these concerns. The original version in the PDF format posted on Idaho DEQ's Web Page did not read the different font size that were used under Castle Creek.
p 71: under applicable bacteria standards, state the current criterion for e-coli.	A table will be added in section 2.4 under applicable bacteria standards.
p 76: under Beaver Creek, revise reference from Camel Creek to Beaver Creek.	This will be modified.
p 94: Table 27: be more explicit on the selected target of stream bank erosion rates instead of just "as defined by load capacity" add between 7.8 and 27.2 tons/mile/year.	This will be explained in greater detail under Section 5.4 to more clearly describe the link between streambank erosion rates and the in-stream sediment loading.
p 95: Clarify what is meant by "the allocation for state WQS for turbidity, MOS, background, and reserve for future growth will be set." Is this in a revised TMDL after post-TMDL monitoring or has part of the load allocation be set aside for future growth and background?	The last paragraph on page 95 will be modified in accordance with previous comments and responses concerning turbidity targets.
p 96: missing "and" in second paragraph between "Table 29....listed segments" and "...on those segments not on the 303(d) list."	This will be modified.
Pg 102: Second full paragraph, recent is misspelled. Appendix D; recommend adding a one to two page sample spreadsheet of data input and output for the SSTEMP model.	The misspelled words will be addressed. Appendix D will add an example of the SSTEMP model.

Comments From: Owyhee County Natural Resource Committee Received by United Sates Postal Service and E-Mailed; November 26, 2002	Response:
Comments: Owyhee County appreciates the effort undertaken by IDEQ in the preparation of the Draft and especially appreciates the honest attempt made by your office to inform and involve both the County Government and the citizens of the county in the development and modification of a document of such importance to the County. The following comments indicate general areas of concern, as well as a number of references to specific areas of the Draft where we disagree with either the approach taken, the resulting use of the data or the inference drawn from the resulting data.	Thank you for your comments.
The Upper Owyhee watershed is a semi-arid climate with heavy but brief precipitation events that negate many efforts at reducing energy loading in that the flashy nature of the streams make the establishment and maintenance of significant streamside vegetation very difficult or impossible. The average annual precipitation is 9 to 11 inches and average temperatures range from 80 to 85 degrees F. During June, July, and August temperatures regularly exceed 100 degrees F. The East Fork Owyhee Subbasin is below Wild Horse Reservoir and reflects the regulated flow of an unnatural stream. Wild Horse Reservoir provides irrigation water to the tribal lands and it is the runoff water from that irrigation that is the water flow in the Owyhee River. The tribal lands have not completed testing or assessment as of this date.	Thank you for your comments.
The County must emphatically point out that the data points or sources of data were extremely limited as admitted in the TMDL. Further, even with more data many of the streams do not and should not qualify for any actions under the TMDL. Further, even with more data on streams that actually qualify for various uses, the prediction model for temperature is fatally flawed and does not represent the real world.	40 CFR 130.2(g) states, " Load allocations are best estimates of the loading, which may range from reasonable accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading." If the commenter wishes to provide any data that would assist in determining the delivery rates from up-land erosion it maybe considered in an amendment to the Upper Owyhee Watershed SBA-TMDL. **Intermittent Waters**. A stream, reach, or water body which has a period of zero (0) flow for at least one (1) week during most years. Where flow records are available, a stream with a 7Q2 hydrologically-based flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with natural perennial pools containing significant

	aquatic life uses are not intermittent(IDAPD §58.01.02.003.53). Since there are no historic flow data in the Upper Owyhee Watershed, streams were classified as intermittent based on USGS Topographic maps. The SSTEMP model has been used for a variety of TMDLs (Rio Chamita, New Mexico; Upper Ponil Creek, New Mexico; Navarro River, California). The Ponil Creek and Rio Chamita TMDLs were the templates and format for the Upper Owyhee Watershed TMDL. All TMDLs mentioned are approved, and thus DEQ believes the model use is an appropriate technique as described in 40 CFR 130.2(g). If the commenter wishes to provide any data that would clearly dispute the use of the SSTEMP model it may be considered in an amendment to the Upper Owyhee Watershed SBA-TMDL.
Considering the miles of stream from 1st to 5th order that are included in the TMDL, the data sources are wholly insignificant and cannot provide reliable indications or predictions of actual conditions on all of those stream miles identified in the TMDL. The TMDL admits that there were few sample sites, that more information is needed, and that sampling problems occurred when the sites dried up. (The Draft admits dried up sites on Pole Creek, Red Canyon, and Castle Creek. Nickel Creek was dry above the springs, and Shoofly Creek was dry above the reservoir. Juniper Basin Reservoir is always dry above the reservoir during summer months. Local ranchers who are very familiar with the area indicate that they have witnessed numerous segments of these streams that regularly dry up. Further, they indicate that even in wet years, the quantity of water in the creeks and river is minimal during the summer hot season.) Furthermore, most of the streams either directly or indirectly (e.g. tributaries) listed in the TMDL have not had adequate use attainability evaluations because many of the identified streams and associated tributaries are not perennial streams but rather are intermittent and/or ephemeral or do not sustain flows sufficient to attain WQS. The TMDL indicates that June temperature standards on the 303d listed streams will not be attained unless the standards are attained on the tributary systems. However, if those systems are intermittent and/or ephemeral they should not be considered in the process at all.	40 CFR 130.2(g) states, " Load allocations are best estimates of the loading, which may range from reasonable accurate estimates to gross allotments, depending on the <u>availability of data and appropriate techniques</u> for predicting loading." If the commenter wishes to provide any data that would assist in determining the delivery rates from up-land erosion it maybe considered in an amendment to the Upper Owyhee Watershed SBA-TMDL. Use attainability analysis is not within the scope of the SBA-TMDL document. Existing uses were determined by the designation by Idaho Department of Fish and Game to manage certain water bodies for wild stock trout. With this management goal, the existing use was established to meet the goals of the management plan. **Intermittent Waters**. A stream, reach, or water body which has a period of zero (0) flow for at least one (1) week during most years. Where flow records are available, a stream with a 7Q2 hydrologically-based flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with natural perennial pools containing significant aquatic life uses are not intermittent (IDAPD §58.01.02.003.53). Since there are no historic flow data in the Upper Owyhee Watershed, streams were classified as intermittent based on USGS Topographic maps. With this definition in mind, the intermittent water bodies must still be meet cold water aquatic life

	standards when sufficient water is available. It would not be expected that the target and allocation within in the TMDL be met when water is absent.
Additionally, even if the data sources were representative and streams were capable of attaining the WQS, the modeling used to determine the TMDL (reduction in inputs) necessary to meet the standards is clearly flawed. Table D-3 (page 188 to 208) show that of 40 stream segments evaluated, 24 would only meet the June standard with 100% shading and the remaining 16 would require 90% shading to meet the standard. Only two streams (Table 29, page 99) would meet the WQS for temperature with less than 90% total shading. While some segments in deep canyons would obtain nearly 35% of the total shading from topography, others with virtually no topographical shading would require 90 to 100% shading from vegetation. Recognizing that different stream types have varying capability for supporting shading vegetation, the conclusion that WQS can be reached through increased shading is obviously wrong. It simply cannot be done in the real world. Flat C type stream channels with fine substrate do not naturally support the woody species necessary to provide 100% shade. Likewise steep A type stream channels running through boulders do not support woody or herbaceous species capable of providing 100% shade. Examples of these situations are shown in Figures E 2, 7, and 10 of the TMDL. The statement on page 101 that the SSTEMP model has proven to provide adequate gross allotments is clearly not valid in the case of this TMDL. A statement in the Draft indicates the belief that if may take between 20 to 100 years to accomplish the results desired in the TMDL. Considering the issue of reducing stream temperature as stated above in this paragraph, Owyhee County would contend that the goals can never be accomplished due to the unique nature of the stream systems found here and the high summer temperatures that exist.	The SSTEMP model has been used a variety of TMDLs (Rio Chamita, New Mexico; Upper Ponil Creek, New Mexico; Navarro River, California). The Ponil Creek and Rio Chamita TMDLs were the templates and format for the Upper Owyhee Watershed TMDL. All TMDLs mentioned are approved, and thus DEQ believes the model use is an appropriate technique as described in 40 CFR 130.2(g). If the commenter wishes to provide any data that would clearly dispute the use of the SSTEMP model it may be considered in an amendment to the Upper Owyhee Watershed SBA-TMDL. The TMDL states that site potential for shade should be evaluated by the land management agencies and the model and the prediction for shading capability can be adjusted as more data is collected.
The Sediment discussion (pages 80 to 88) regarding upland contribution fails to acknowledge the alteration of sediment production associated with Western juniper invasion and conversion of uplands from sagebrush-steppe to juniper woodland. The change in vegetation significantly impacts watershed function in that the timing and volume of water produced is vastly altered. The change in vegetation changes the relative importance of the K Erodability Factor as well as the significance of slope. Juniper invasion increases the surface flow	If data can be provided showing the increased sediment from Juniper woodland areas it maybe considered for an amendment to the TMDL. If data is available to show the cause of the loss of understory and the resulting loss of fire frequency can be associated with some natural or un-natural source it may be considered in a modification to the SBA-TMDL. In May of 2000, a letter was submitted to the

during snowmelt and precipitation events and reduces infiltration, thus changing the timing and amount of watershed production during the year. The amount of water produced is also reduced due to the high water use potential of Western juniper. Clearly, the invasion of juniper over much of the area should be thoroughly evaluated and considered in the TMDL, particularly in relation to sediment production from uplands. Owyhee County does not accept the presumption, on page 29 of the Draft, that the current land use of livestock grazing is the cause of the juniper invasion. Juniper invasion has resulted from the removal of regular fire cycles from the landscape. Juniper invasion will continue to be a destructive force in the landscape until the juniper invasion problem is recognized for the damage it does to wildlife and water quality values and is dealt with in an effective way. Even the BLM has recognized the juniper issue in the Owyhee Resource Management Plan which plans for the removal, through burning, of a minimum of 7,500 and maximum of 15,000 acres annually for the twenty-year life of the plan. Juniper is invading into Red Canyon, and the upper reaches of Deep and Pole Creeks. The Draft has not adequately analyzed juniper's dominance in the plant community and the associated effects on water quality in the form of increased erosion, sedimentation and extraction of water from flows within the watershed.	commenter requesting any and all data pertaining to the Upper Owyhee Watershed. At that time the commenter did not respond with data that would show the cause and affect of Juniper invasion on water quality.
The TMDL indicates on page 102 that the modified universal soil loss equation was relied on to estimate watershed sediment yield from uplands. The TMDL should acknowledge that the MUSLE is not recognized as a valid and reliable indicator of potential soil loss from rangelands. The modifications of the USLE do not and cannot account for the variation found on rangelands within an entire watershed.	The use of the MUSLE was used as a tool to identify possible sources of sediment. The model or the results were not used in the final load allocations. If the commenter wishes to provide an appropriate technique that would assist in determining erosion rates and/or delivery rates from the Upper Owyhee Watershed, it may be considered for an amendment to the TMDL.
The discussion of allocation on page 104 indicates the TMDL will consider the forested land (this should be corrected to identify the woodlands and seral juniper woodlands not forested land) as part of the primary land use for rangeland. This approach completely disregards the true impact of invading juniper and should be changed. Seral juniper woodlands should be identified as a primary contributing factor in the changing of the timing and amount of both water and sediment production form uplands.	The reference to the Juniper woodlands identified as not fitting the overall description as forested lands was meant to show that this land use does not usually fit the general forest lands description where forest management is the principle source of pollutants. If data can be presented to discuss the possible sediment load associated with the invasion of Juniper it maybe considered for an amendment to the Upper Owyhee TMDL.
Page 18 of the Draft refers to the loss of beaver during the 1800's and page 32 makes reference to the watershed as having at one time supported a	The information compiled by Work (1830-31) that there may not have been many "signs" of beaver in the Upper Owyhee Watershed is not disputed.

viable population of beavers. It appears that the inference is that the region could, or should, once again support a significant beaver population. We question not only the validity of the statements but also the potential for reintroduction of any significant beaver population. The Draft cites presence of fine sediments forming fertile soils areas along stream corridors as proof of the presence of a previous viable beaver population. Historic records, however, contradict the presence of beaver in any significant numbers. From John Work's Field Journal 1830-1831 Expedition, edited by Francis D. Haines, Jr. comes the following information: "May 28, 1831 near Humboldt and Bruneau rivers, "During this days march the river is well wooded with poplar and willows yet there is very little appearance of beaver. Only 3 were taken today." In the 1820's, Hudson's Bay Company sent out expeditions to turn the Snake country into a "fur trappers wasteland", attempting to discourage further American encroachment of the Northwest. The first expedition was Peter Skene Ogden in 1824. John Work was commander of a brigade exploring the Portneuf River, Bruneau, Humboldt, and drainages of the "Sandwich Island" River (the Owyhee). The June 1, 1831 journal entry reflects: "…East fork of Sandwich island river. This little valley is about 20 miles long and 15 wide. A small fork falls in from the S, 2 from the E, and 1 from the W. all of which form one stream which runs N.W. through a narrow channel bounded by impassable rocks. The different forks in the valley have some willow on their banks and seem well adapted for beaver, yet the men complain that the marks of beaver are scarce." (Note, this site is now occupied by Wild Horse Reservoir.) As the expedition traveled westerly toward the south Fork Owyhee, they continually complained about the lack of beaver. The expedition traveled down the South Fork of the Owyeee, to the Snake. The only other wildlife were antelope. This was the first "European influence" in the Upper Owyhee drainage. Owyhee County doubts the trapping of beaver caused the deeply eroded stream channels as inferred in the Draft. It more likely occurred from natural causes prior to the arrival of the "European influence." Regarding the potential for reestablishment of viable beaver populations, in the photos within the Draft there are no visible food sources for beaver. Juniper is neither a food source nor a dam building material used by beaver. The Draft seems to indicate that Castle and Pole Creek have evidence of beaver but that current land use practices have been at fault in the removal of vegetation necessary for the reestablishment of beaver. The Draft also does not seem to have	However, the presence of European influences in southwest Idaho is documented in 1813 when Donald McKenzie first explored the area with the Pacific Fur Company. By 1818, McKenzie was operating fur trapping operations from the Boise River area to Bear Lake and the upper reaches of the Snake into what is now Yellowstone. Somewhere between 1819-20 three members of the McKenzie party had set out to explore the "Sandwich Island" Rivers, but never returned, assumed killed by local Native Americans. In 1826, Peter Ogden transversed the Owyhees and Burnt Rivers when they had a very successful trapping experience. Again in late summer of 1826 Thomas McKay set out to trap the Upper Owyhee Area with varying success. Peter Ogden also returned to the Snake River area in 1827 during the period when the Hudson Bay Company initiated the "scorched stream policy." This policy was to create wastelands so the Americans would not want it. The statement that the rivers were well wooded with cottonwoods , willows and popular would indicate at the time that ground water near the stream was still available. There is mention of the beavers and the hydrologic function their dams provided. It is well documented that the re-introduction of beavers in the Wood River Basin has increased water supply, reduced erosion and provided a inexpensive alternative to in-stream mechanical controls. The beavers play an important role in the hydrology of a watershed. As water is dammed up behind structures, especially during high flows, water energy is dispersed onto the flood plain. As the energy decreases, fine sediment has the opportunity to deposit. Water is also percolated into surrounding soil. This water is re-released back into the water body and/or is used for woody plants along stream corridors. The SBA-TMDL does not recommend management actions as this will have to occur on a site by site bases. However, it would be premature to discount the re-introduction of beaver into areas that could support this practice.

considered that reintroduced beaver populations would remove significant portions of the very vegetation that is proposed to be necessary for shading and energy reduction.	
The Draft indicates that past and current land use altered vegetation of many of the riparian areas, cut down and incised stream beds and caused loss of access to historic flood plains. While livestock grazing may have contributed to riparian degradation prior to the passage of the Taylor Grazing Act of 1935 that has not been the case since the establishment of managed grazing systems and modern grazing management. Modern grazing management systems are not degrading streams. While taking a "historic" look at a landscape might seem to be useful or even necessary, we should always be aware that we cannot manage for what once existed since natural systems are always in a state of change. We can manage for some future condition, but we can't, and shouldn't try to, go backwards.	Comment Noted. The intent of the TMDL will not be to restore the area to pre-anthropogenic influence. The intent is to restore area streams to full support of beneficial uses and compliance with water quality standards.
The Draft refers to the conversion of flood plain meadows to hay and pastures but fails to indicate how many acres of low gradient streams or old wet meadows are converted to non-native pasture or hay fields. Review of maps or aerial photos show very isolated irrigated areas and irrigation is not consistent throughout the watershed.	Statistics for land use for each 5th Field HUC is located in Appendix B. These statistics show the amount of lands classified as irrigated.
Regarding the reference to a steelhead fish remnant on page 30 of the Draft, the item is interesting, but hardly useful as evidence of the extent or quality of any historic fishery found within this subbasin. Without other documentation to show the evidence of a fishery, this remnant could easily be explained as having been brought to the area by humans rather than having arrived under its own power and via the tributaries of the watershed. Petroglyphs in the Owyhees, for example, have not shown fish. In addition to the possibility previously mentioned, there was a fish hatchery at Ontario, Oregon in approximately 1900, that released salmon and other fish into the tributaries of the mid-Snake, including the Owyhee. A number of other issues relating to fisheries exist within the Draft. The Draft states that, regarding Juniper Basin Reservoir, "no data found to determine if aquatic life is an existing use.", and also indicates that Kamloops trout were planted by Idaho Fish and Game in the private reservoir known as Blue Creek Reservoir. The draft indicates that Fish and Game have management plans for these two water bodies that give some credence to their consideration as fisheries subject to the water quality standards for salmonid	It is well documented that both Steelhead Trout and Coho Salmon migrated into the Owyhee River drainage prior to the construction of dams on the Columbia, Snake and Owyhee Rivers. Salmonid spawning was not recommended as a designated use for either Blue Creek Reservoir or Juniper Basin Reservoir. The Idaho Department of Fish and Game management plan only indicated that Blue Creek be managed for cold water aquatic life. Juniper Basin Reservoir has a TMDL developed to address cold water aquatic life until; a designation can be made that the existing use is another aquatic use besides cold water aquatic life. This designation can only be made through the legislative process by the state of Idaho, with approval by the US Environmental Protection Agency.

spawning. We question this approach, in particular since the species introduced in Blue Creek Reservoir does not spawn in the type of system into which they were introduced the population will only remain so long as Fish and Game continues to stock the water body. Regardless of temperature changes or whatever other water quality conditions are changed, these fish will never be self- supporting and should not be the basis upon which we are required to measure success in achieving the requirements of the Clean Water Act.	
The Draft does not show flow measurements at monitoring sites. Flows must be greater than 5cfs for recreational uses and water supply, and equal to, or greater than 1 cfs for aquatic life uses.	Mean annual flow data was obtained through the use of discharge model data (Hortness and Berenbroock 2000) and was used to determine minimum flow levels. All water bodies except the small watershed of Nickel Creek exceeded the 1 cfs criterion for cold water aquatic life. However, the model indicated that the entire Nickel Creek watershed would exceed the 5 cfs criteria for the primary contact recreation flow criteria and the 1 cfs cold water aquatic criteria. The only other watershed that showed the that the 5 cfs criterion would not be met was Juniper Basin at an annual discharge at 1.96 cfs. It should be noted that Juniper Creek is not being recommended for primary contact recreation, but the reservoir itself will be. This will be clarified in Table 25 (old Table 23).
Concluding Comments: Allocations are gross estimates that IDEQ has made with the belief that, once more data is collected by appropriate land management agencies, refinements to the allocations can be made. While our experience with the Boise Regional Office of IDEQ has shown both the intent and willingness to take such appropriate follow-on action, that has not been our experience with other agencies. Even though we would expect The Boise Regional Office and IDEQ to honor its commitment for follow-on study and adjustment of the management practices, we must plan for what has become our most common experience in this vein. It has been our experience with the Bureau of Land Management that, once approved, plans are executed without regard to the economic havoc they create, without any real commitment to continued monitoring for the effectiveness of the management actions and without any subsequent modification. This experience leads us to take the position that the TMDL and subsequent Implementation Plan must be carefully reviewed and revised to ensure that the implementation behavior we have come to expect from the federal agencies is carefully fenced so as to do the least harm to the economy of the county and	Thank you for your comments. DEQ understands the balance needed to ensure a sound county economy and improved water quality. Past experience in this area has led DEQ to believe that implementation plans can be agreed upon and be workable documents. Additionally, DEQ will continue to provide a monitoring presence that will confirm the success or failure of management actions. In addition, DEQ welcomes appropriate data from sources outside designated management agencies.

to ensure that the efforts of all concerned are focused on pursuing those actions that have real benefit for the watershed and real potential for success. We believe that the issues raised in this comment paper, in conjunction with those presented during reviews of previous TMDL's and Implementation Plans where we have pointed to the attainment of beneficial uses, despite the presence of data indicating that water quality standards are not being met, should cause IDEQ to perform Use Attainability Analysis on the watersheds of southwestern Idaho. We believe that the evidence presented clearly shows that the standards for temperature on the streams within this area of Idaho have been incorrectly set. We maintain that the goals of this TMDL, and others, with respect to temperature reduction are not necessary in order to achieve the beneficial uses, are not achievable due to the natural background conditions, and will cause undue harm to the economy of Owyhee County. We believe that EPA's interpretation of the Clean Water Act has presented a problem to the western states that can only be resolved by addressing the fallacy of the current temperature standards. We also believe that, in light of the current regulatory environment, it is the only option IDEQ has available if its goal is to take those actions that will be of actual benefit in the watershed.	If data exists which indicates that any of the streams we have proposed for the §303(d) list are in compliance with cold water aquatic life temperature standards, DEQ encourages public input with data to support this position during the §303(d) listing process. Whether or not the cold water aquatic life temperature standard is appropriate for these streams or not was not within the scope of this SBA-TMDL. A less stringent WQS may be suitable for these streams, but this type of decision can only be made upon completion of a Use Attainability Analysis (UAA). While UAAs may be a future task for DEQ, the completion of SBAs and TMDLs in accordance with a court ordered schedule is DEQ's top priority. Thank you for your comment. DEQ will continue to work toward refining its understanding of the issues with the end goal of benefit to the watershed.

Comments from: Bruneau River Soil Conservation District	Response:
We feel that setting target loads for intermittent streams is not appropriate.	**Intermittent Waters**. A stream, reach, or water body which has a period of zero (0) flow for at least one (1) week during most years. Where flow records are available, a stream with a 7Q2 hydrologically-based flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with natural perennial pools containing significant aquatic life uses are not intermittent (IDAPA §58.01.02.003.53). Since there are no historic flow data in the Upper Owyhee Watershed, streams were classified as intermittent based on USGS Topographic maps.
We request that DEQ accept information gathered within the year to make appropriate TMDL adjustments, de-listing portions, or all of Pole Creek, Deep Creek, Castle Creek, Battle Creek, Shoofly Creek, Red Canyon Creek, and Nickel Creek.	DEQ will continue to provide a monitoring presence that will confirm the success or failure of management actions. In addition, DEQ welcomes appropriate data from sources outside designated management agencies. If data exists which indicates that any of the streams we have proposed for the §303(d) list are in compliance with cold water aquatic life temperature standards, DEQ encourages public input with data to support this position during the §303(d) listing process.
We also feel that with limited to no data on Camas Creek, Camel Creek, Dry Creek and Beaver Creek, they should not be added to the 303(d) list.	The SBA proposes these streams for listing on the next 303(d) list based on appropriate data. Additional evaluation is needed in the future to determine whether a TMDL will be required.
Since Succor Creek is in another watershed, bank erosion estimates for Succor Creek should not be applied to streams in the Upper Owyhee watershed.	This is the only available data that would offer some comparison. The streambank erosion rates for Succor Creek were placed in the document only to demonstrate the variability of streambank erosion associated with the arid deserts in southwest Idaho. In the same section the document reads, "As more streambank information is collected by land management agencies the values in Table 34 will be adjusted." If there is other streambank erosion rates available and has a specific application to the Upper Owyhee Watershed, it may be considered for an amendment to the Upper Owyhee Watershed SBA-TMDL.
The District requests that DEQ properly evaluate these streams in 2003, in cooperation with partner agencies and watershed landowners.	DEQ will continue to provide a monitoring presence that will confirm the success or failure of management actions. In addition, DEQ welcomes appropriate data from sources outside designated management agencies.

Also shading and stream width targets should not be set by DEQ, but rather alternative prescriptive measures need to be established through the TMDL Implementation Plan.	Table 28 provides the mass/unit/tame requirement for a TMDL. The measurement of joules/meter^2/second is the link for the surrogate measurement of the required percent shade to achieve the State WQS.